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BULLETIN 491-509
JUNE, 1952

71

Operating Policies and Practices of
Cooperative Purchasing Associations
in Mississippi

134196

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TABLE OF CONTENTS

Chapter Page

ACKNOWLEDGEMENTS 2

I. INTRODUCTION 5

II. THE POLICIES OF ORGANIZATION AND OPERATION OF PURCHASING COOPERATIVES IN MISSISSIPPI 6
- Years of Operation 6
- Agencies Organizing the Cooperatives 6
- Funds for Organization 8
- Funds for Investment 8
- Funds for Operation 9

III. MEMBERSHIP COMPOSITION 9
- Number of Members 9
- Composition of Members and Attendance 10
- Informing Members 10
- Other Membership Functions 11

IV. DIRECTORS AND THEIR RELATIONSHIP TO THE COOPERATIVES 12
- Number of Directors and Terms of Office 12
- Attendance of Directors and Frequency of Meetings 13
- Electing and Replacing Directors 13
- Participation of Directors 14
- Salaries of Directors 14
- Other Practices Concerning Directors 14

V. MANAGEMENT POLICIES, PRACTICES, AND RELATIONSHIPS TO THE COOPERATIVES 15
- Length of Service 15
- Change of Managers 15
- Training Program 16
- Education and Training 16
- Salaries of Managers 16
- Method of Paying Salaries 17
- Salaries and Volume of Business 17
- Salaries and Net Margins 18
- Salaries and Experience 18
- Salaries and Education 18
- Other Management Practices 19

VI. GENERAL POLICIES AND PROBLEMS IN THE OPERATION OF THE COOPERATIVES 19
- Accrued Savings 19
- Repaying Equities 20
- Meeting the Desires of the Members 22
- Selling Price Determination 22
- Establishment of Prices Paid to the Farmer 23
- Advanced Price to Producers 23
- Financial Statements 23
- Use of Financial Statements 24
- Credit Practices and Policy 25

TABLE OF CONTENTS—Continued

Chapter Page

VII. A COMPARISON OF THE FINANCIAL RATIOS OF THE VARIOUS COOPERATIVES 25
  Current Assets to Current Liabilities 25
  Accounts Receivable to Current Assets 26
  Net Margins to Current Liabilities 27
  Net Margins to Total Assets 28
  Purchases by Patrons to Accounts Receivable 29
  Fixed Assets to Total Assets 30
  Cost of Goods Sold to Merchandise Inventory 31
  Gross Margins to Gross Purchases 31
  Operating Expenses to Total Volume of Business 31
  Salaries and Wages to Gross Volume 32
  Net Margins to Total Volume 33

VIII. SUMMARY 34

The Operating Policies and Practices of Cooperative Purchasing Associations In Mississippi

By LEWIS P. JENKINS

CHAPTER I

INTRODUCTION

Cooperative purchasing associations have been in operation in Mississippi since about 1890. The Farmers' Alliance, organized along fraternal lines, started several purchasing associations very similar to the present day purchasing association. These associations were short-lived and by 1900, they were practically out of existence.

In the early 1900's the Farmers' Union was organized in Mississippi. During the time of this development, local stores were organized which handled staple commodities needed by farmers. These purchasing associations were also short-lived since they followed such practices as: operating without adequate finances, engaging in price slashing and price wars, and being operated by politicians in many cases. As a result of the above type of operations, purchasing activity among cooperatives was very slow to develop from 1915 to 1920.

With the depressed conditions in Mississippi in the early 1920's purchasing cooperatives again came into existence. This development began with various county agents starting small farmers' associations that purchased mostly fertilizer. By 1923, these associations were organized under the Mississippi Farm Bureau Federation which was a wholesale purchasing and marketing unit. The local associations were called County Farm Bureau Cooperatives.

Up until 1936, the purchasing units continued to operate under the above name. They then reorganized and took the name of ______________ County Cooperative (AAL) and became a part of the present Mississippi Federated cooperatives (AAL) which took over the wholesale activities previously carried on by the Mississippi Farm Bureau Federation (AAL).[1]

Since 1936, there has been no change in status of the purchasing associations described above. There has developed since 1940, however, the Delta Purchasing Federation with its five local units. There are also several local associations that operate individually and have not affiliated with either of the federations.

At present there are over 50 purchasing associations in operation in Mississippi. They have an average membership of over 1,000 and an annual volume of business that exceeds five million dollars.

These purchasing associations have operated principally in the Upland areas of the state, however, there has been a recent development of these associations in the Delta area.

The purposes of this study of purchasing cooperatives were: (1) to provide recent information for instructional purposes in college courses in cooperation; (2) to provide workers in the agricultural field with recent information concerning the existing framework of associations and the services being performed by them; and (3) to provide managers, directors, and members of cooperatives with information that would enable them to make a better evaluation of their individual associations. In view of these needs the study was undertaken to fill in part the gap in the lack of present-day information relating to purchasing cooperatives in Mississippi.

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[1] (AAL) The initials A. A. L. in parenthesis mean "Agricultural Association Law." Any association incorporated under the Agricultural Association Law of Mississippi passed in 1924 and amended in 1930, must include the initials (AAL) as a part of its legal name.

The objectives of the study may be stated briefly as follows:

1. To study and evaluate the organization and operating practices and policies of purchasing cooperatives.

2. To analyze the business operations of the cooperatives and determine the relationships among the practices followed and strength or weakness of the associations.

The business analysis has been made by using the method of ratio comparisons. This contrasts the least favorable group of cooperatives and the most favorable group, with the average for the entire group. The significance of each ratio is presented together with both its possibilities and its limitations. By making this type of analysis various degrees of efficiency may be pointed out.

The data upon which this study is based were obtained in the summer of 1949 by the survey method and from annual audit reports of the individual associations. An 80 percent sample was drawn consisting of 40 purchasing associations (Figure 1).

Information obtained by the survey method pertained to general operating practices and policies and was secured by personal interviews with the managers of the associations. The information concerning the operating ratios was obtained by making a copy of the annual audits of each cooperative for three years of operation, 1946-1948. In making the analysis of these data the three-year average was used. Four cooperatives out of the 40 studied were excluded from the ratio analysis since adequate records for three years were not obtained.

CHAPTER II

THE POLICIES OF ORGANIZATION AND OPERATION OF PURCHASING COOPERATIVES IN MISSISSIPPI

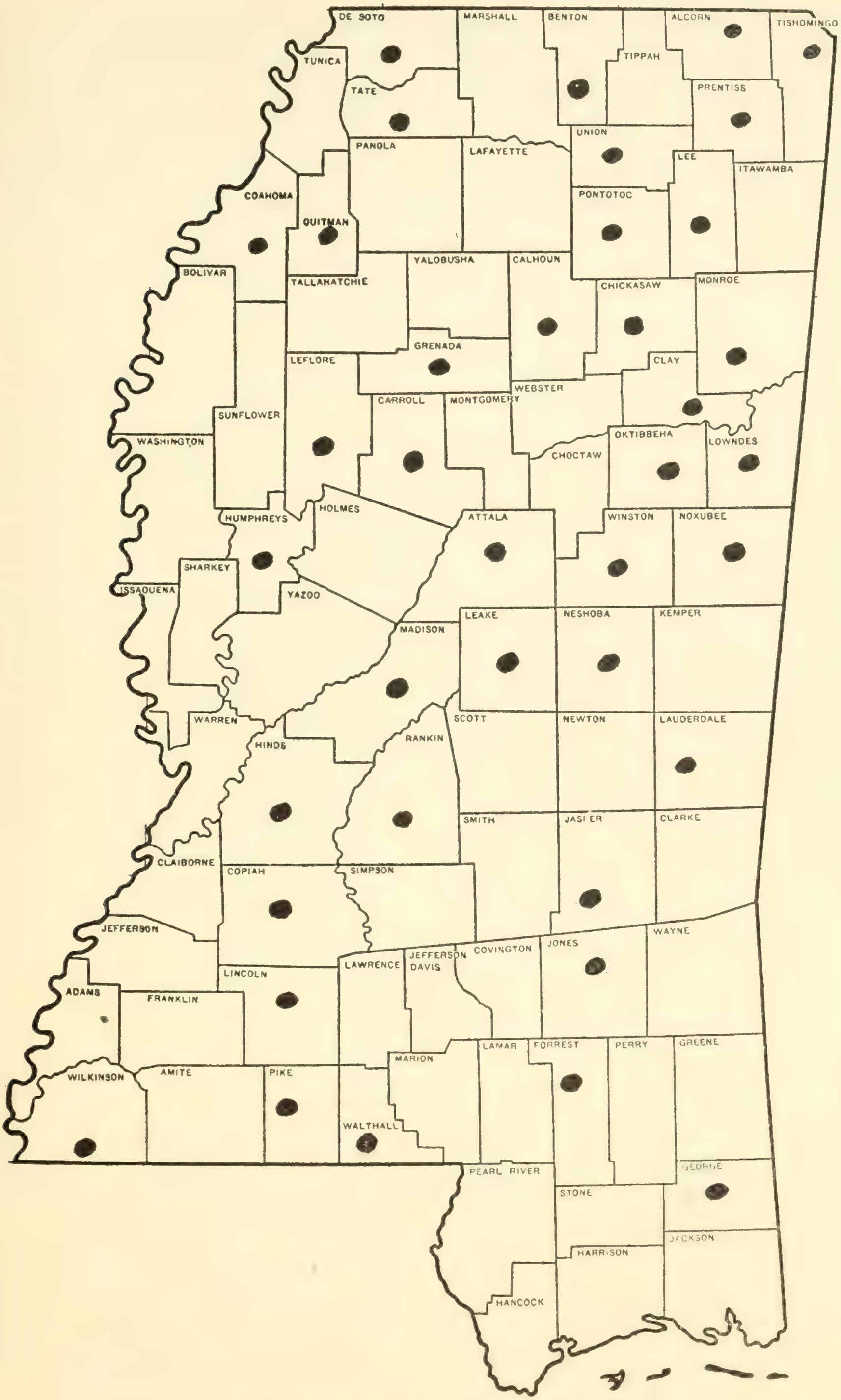
Years of Operation

The number of years of continuous operation by the various cooperatives ranged from 23 years to less than one year. There were two major periods in which cooperatives were organized in Mississippi: 1934-1938, and 1944-49. In the former period 15 of the associations were organized or reorganized, while in the latter period 19 were organized.

There were only five associations in operation that were organized before 1934. They were organized in the period of 1925-1931. The remaining association was organized in 1941. The cooperatives organized in 1934-1938 have been in operation for an average of 13.5 years, while the 19 organized in 1944-49, had an average of three years of continuous operation. The five organized before 1934 had an average of 19 years of continuous operation. The average number of years of continuous operation for the entire group was slightly more than nine years. Twelve of the 40 associations had been reorganized since their original charter was granted.

Agencies Organizing the Cooperatives

The initiative of the farmers and the county agents working together was responsible for the organization of 22, or 55 percent, of the associations (Table 1). The farmers working alone were responsible for organizing 17.5 percent of the cooperatives. The farmers and Mississippi Federated Cooperatives (AAL) working together were responsible for 15 percent of the cooperatives being organized. A combination of farmers, Mississippi Federated Cooperatives (AAL), and county agents was responsible for organizing 7.5 percent of the associations. The remaining (five percent) associations were organized as the result of the initiative of a com-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ITAWAMBA
COAHOMA
PONTOTOC
QUITMAN
YALOBUSHA
CALHOUN
BOLIVAR
TALLAHATCHIE
CHICKASAW
MONROE
GRENADA
LEFLORE
CLAY
WEBSTER
CARROLL
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WASHINGTON
OKTIBBEHA
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ATTALA
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NOXUBEE
SHARKEY
ISSAQUENA
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
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LAUDERDALE
WARREN
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WAYNE
JONES
COVINGTON
JEFFERSON DAVIS
LAWRENCE
LINCOLN
ADAMS
FRANKLIN
LAMAR
FORREST
PERRY
GREENE
MARION
WILKINSON
AMITE
PIKE
WALTHALL
PEARL RIVER
GEORGE
STONE
JACKSON
HARRISON
HANCOCK

Figure 1. Location of county cooperatives included in the study.

Table 1. Agencies taking the initiative in organizing the cooperatives.

Agency or agencies	Number of associations organized
Farmers and county agents	22
Farmers alone	7
Farmers and Mississippi Federated Cooperatives	6
Farmers, Mississippi Federated Cooperatives, and county agent	3
Others	2
Total	40

bination of the farmers, Farm Security Administration, and Farm Bureau Federation.

Funds For Organization

Funds for organizing 21 of the associations were obtained from private individuals (Table 2). Usually the associations took a collection among the farmers and obtained the necessary funds to be used for traveling expenses, paying for the charter, and other incidental expenses.

The Farm Bureau Federation provided funds for organization in five of the cooperatives. In these cases the cooperatives grew out of the old Farm Bureau Federation that started about 1920. In two of these cases the cooperatives were called the County Farm Bureau Association until they were re-chartered and renamed. In three of the cooperatives county agents contributed the necessary funds for organization. The Mississippi Federated Cooperatives (AAL) were the source of organizational expenses for two of the associations. In three associations collections were taken from donating farmers. Later when the organization was established, Certificates of Equity were issued to these farmers for the amount that they had donated previously.

Other agencies that aided in furnishing funds for organizational expenses were: Farm Security Administration, Tennessee Valley Authority, and Seed Loan Association. These agencies participated in the organization of the four cooperatives in order that they might have some local agency to aid them in carrying out their particular program. In two associations information on how their funds for organization were obtained was not available, because they were operated by new managers who had not learned how the original funds for organization were secured.

Table 2. Source of funds for expenses incurred in organizing cooperatives.

Contributors	Number
Private individuals	21
Farm Bureau Federation	5
County agents	3
Certificates of Equity	3
Mississippi Federated Cooperatives	2
Others	4
Unknown	2
Total	40

Funds For Investment

The source of funds for original investment is very important since it plays a major role in the actual operation of a cooperative association. The sources employed in securing these funds are presented in table 3.

The practice of using accumulated savings for financing was most prevalent. This method involved starting with an unusually small amount of funds, securing the goods on time, and then making payment after the goods were sold. Financing associations by using accumulated savings may retard the development of the organization. For example, if an association needed to install some seed-cleaning equipment to render a needed service, it might have to wait for quite some time before enough savings could be accumulated to purchase the necessary equipment. The delay involved could easily be a handicap to the most economical development. There is also the possibility that the financing of cooperatives by the use of accumulated savings might fail to create an interest of self ownership among the members of the association.

Table 3. Sources of funds for original investment purposes.

Agencies	Number	Percentage
Accumulated savings	11	27.5
Mississippi Federated Cooperatives	6	15.0
Certificates of Indebtedness	8	20.0
Bank for Cooperatives	8	20.0
Private banks	3	7.5
Other sources	2	5.0
Unknown	2	5.0
Total	40	100.0

The associations using the method of issuing Certificates of Indebtedness to raise funds for original investment were the only ones that actually obtained money directly from their members. The associations following this practice canvassed the producers and issued the Certificates of Indebtedness for the amount of money received from the members. This method would seem to offer the advantage of creating a stronger interest of the farmers in their cooperative due to their expressed interest in the form of money advanced.

The cooperatives obtaining funds from the Bank for Cooperatives could not obtain all of their funds from this source since only a certain percentage of the total could be borrowed. However, this source was listed as the major one used by the third group (Table 3).

In the cases where the Mississippi Federated Cooperatives (AAL) were listed as the source of credit it was indicated that the cooperative must first put up part of the necessary funds similar to the requirements made by the Bank for Cooperatives.

Funds For Operation

Funds for operation of the cooperatives were obtained through credit extended from the Mississippi Federated Cooperatives (AAL), commercial banks, personal notes of the manager, and credit secured from other local cooperatives.

Thirteen of the 40 cooperatives reported that they had enough money for operations throughout the year. The remaining 27 reported that they had to borrow money for operations for a short period of time. The major source of this credit was from the Mississippi Federated Cooperatives (AAL). By an agreement between the Federation and the local cooperatives that are members of the Federation, the locals are allowed to purchase goods from the Federation on a 30- to 60-day credit plan. Under this credit arrangement the associations could build up a large inventory in their peak periods of sales and meet the needs of their members, even though their local funds were inadequate to do this.

Only five of the associations secured credit for operation from sources other than the Federated Cooperatives. The sources of credit for these associations were from commercial banks and from other local cooperatives.

CHAPTER III

MEMBERSHIP COMPOSITION

Number of Members

There were over 57,000 active members in the 40 cooperatives at the end of the fiscal period, June 30, 1949, or an average of about 1,600 per association. The number would have been much greater, if the inactive members, who have equities in the associations, had been included. A further classification of the individual associations, by number of members is shown in Table 4.

There were two important reasons for the variation in the number of members in the various cooperatives. In most cases, the associations that had been in operation for several years had the largest membership. The exception to this may be accounted for by the limitations that some cooperatives have concerning accepting new members. They require either a certain fee, acceptance by the board of directors, or a combination of both. In five of the eight associations reporting less than 500 members, a membership fee ranging from one to ten dollars was

Table 4. Distribution of cooperatives according to membership.

Number of members	Number of cooperatives	Average membership
Under 500	8	245
500 - 999	8	741
1,000 - 1,999	12	1,427
2,000 and over	12	2,693

required, in conjunction with being approved by the board of directors. This restriction on membership tended to keep the number very small. Usually the associations having the largest membership had a very lenient policy of accepting members.

The lenient policies included such practices as counting all patrons as members or by asking the patrons to sign a membership application with immediate approval by the manager, or by unquestioned approval by the board of directors at some later date.

All of the associations reported a gradual increase in membership as the age of the cooperative increased. However, the associations having less than 500 reported that their membership increase was not as rapid as the other groups (Table 4).

Composition of Members and Attendance

The composition of membership seemed to have some relationship to the average attendance at the annual meeting. This relationship is shown in table 5.

It is possible that barbecues and picnics drew a large attendance to the annual meeting and gave the second group the best average attendance. Also, the cooperatives having the highest percentage of landowners as members had a higher percentage attendance when associations other than the ones giving barbecues were considered. Associations following the practice of membership selection also had better attendance. In this method of selection the board of directors refused membership to persons whom they felt would not be good cooperators. In most cases their membership was composed of less than ten percent tenants. Since members in these associations were selected they probably represented a more interested group and, therefore, tended to go to the annual meeting. Even though it is hard to establish any relationship between a high percentage attendance in members and the strength of the cooperative it is likely that this does contribute some strength to the association.

Table 5. Composition of membership in relation to average percentage attendance at annual meeting.

Percent landowners	Number of coopera-tives	Average percent attend-ance
Below 50	5	10.0
50 - 74	18	23.0
75 and over	17	20.0

Twenty-three or 57.5 percent of the associations actually had less than 12 percent of their membership at their annual meetings. Fourteen of these associations had an average of less than five percent of their membership present. Two of the associations in this group actually had only one percent of their members present, and one of these associations reported that members were called in from the street in order to get a sufficient number to constitute a quorum. It should also be noted that the number of members which constituted a quorum was very small. When asked why it was necessary to call in members from the street, it was stated that the members were satisfied with conditions as they existed, and that they did not care to devote any of their time to the meeting. When this condition exists there may also be a lack of interest on the part of all concerned in the operation of cooperatives of this type.

The managers who could report a large percentage attendance seemed to be very proud of the fact. It is believed that they felt an informed and active membership was desirable.

Informing Members

The method employed by the associations in disseminating information to the members resulted in various combinations which are shown in Table 6.

The associations resorting to annual meetings as the only method of informing their members usually followed the policy of reading the annual financial statement, and voting on a few matters pertaining to the operation of the association. Only an average of about two hours was spent in these meetings by most of the associations.

With only one meeting of this type

Table 6. Methods used by cooperatives in disseminating information to members.

Method used	Number
Annual meetings and personal contact	8
Annual meetings only	7
Annual meetings and periodicals	6
Annual meetings and field service	5
Annual meetings, personal contact and periodicals	5
Others	5
Total	40

per year it seems that this method of informing the members concerning the operation of the cooperative is very weak.

Twenty percent of the associations used the method of personal contact and annual meetings as a means of informing members about their organization. Use of personal contact consisted of discussions between the manager and the members as they came into the cooperative to trade. In most cases this type of education consisted of discussing the price of various commodities needed by the farmer, possible market outlets for the farmer's products, and the needs in general of the farmer.

The group using the combination of annual meetings and periodicals represented 15 percent of the total. The periodicals consisted of the **Mississippi Federated Coop News** which is a monthly publication of the Mississippi Federated Cooperatives (AAL), mimeographed material by the individual cooperative, and various advertising pamphlets left with the association by different business establishments.

The **Mississippi Federated Coop News** furnished information about the loan prices for cotton, prices of other products handled, methods of preparing permanent pasture, information on some of the local cooperatives, etc. This house organ presented information that was very helpful in informing the membership about cooperation.

The fourth group combined field service with their annual meetings by carrying out field demonstrations with the farmer. These demonstrations were primarily a means of selling such articles as lime spreaders and other commodities used in the demonstrations.

The fifth group informed their members by annual meetings, personal contact, and periodicals. One association was publishing its own periodical, which was a monthly news letter published by the manager and other personnel of the individual cooperative. Upon reviewing several of these news letters it was found that they contained such items as the method of allocating net margins, volume of business of the association in various commodities, prices of various commodities, and other pertinent information concerning its activities. This type of educational program had much to offer in enlightening the membership and is worthy of consideration in this phase of cooperative policy.

The group presented as "other" in table 6 used various combinations of methods such as field service, periodicals and annual meetings, and personal contact.

Four associations using the annual meeting as the only means of informing the membership actually had the lowest attendances at their annual meetings, with attendance, of one, one, two, and five percent, respectively.

Other Membership Functions

In order to become a member of the association 30 of the 40 cooperatives required the person trading with the association to sign a membership card, which was approved by the manager at that time or by the board of directors at a later date. Two associations followed the practice of including on the sales slip an application for membership, thus, when the member signed his name to the sales slip he automatically became a member. Seven of the associations charged a membership fee of one dollar or deducted the first dollar that accrued to the individual's equity account. This requirement was more common in stock associations than in non-stock associations. One of the associations required the person to pay a membership fee of ten dollars in order to become a member of the organization.

In 13 cooperatives the manager approved the membership applications.

In 25 the board of directors passed upon the members, but in most cases this was more of a formality rather than any form of membership selection. The remaining two associations considered all persons who traded with the association as members and therefore, no approval was required.

Each member was allowed one vote in all matters voted on by the association in special meetings or regular annual meetings.

Several associations were completing their files of active and inactive members at the time of study. The inactive members were ones who had equity in the association but had not done any business with the association in two years. This list was being prepared in order that a person must be actively engaged in trading with the association in order to have a voice in the operation of the association. This procedure, however, did not affect his equity in any way, since all cooperatives must treat members and nonmembers alike in returning the patronage refund.

CHAPTER IV

DIRECTORS AND THEIR RELATIONSHIP TO THE COOPERATIVES

Number of Directors and Terms of Office

The number of directors per cooperative ranged from five to eighteen. Twenty-nine of the cooperatives studied had seven members on the board. Only three had less than seven while eight had more than seven. There seemed to be no relationship between the size of business and the number of directors. The associations having 15 to 18 directors were some of the larger associations in volume but other associations having only seven directors had comparable volumes.

Thirty-one of the cooperatives elected the directors for a period of two years and practiced the staggering method of election. Seven of the associations elected their directors for a term of only one year. Of the remaining two cooperatives, one followed the practice of electing the directors for a period of three years, while the other elected its directors for an indefinite period.

When cooperatives do not follow the staggering method of election it becomes possible to have a completely new board elected at one time. This may not be to the best interest of the cooperative, since new board members may not be well enough informed on the cooperative's structure to render the best service. With the small number of members attending the annual meetings in some of the associations it would be possible for an organized faction to step in and gain control of the association by electing a completely new board from their group. Even though it is possible for an entirely new board to be elected at one time, the turnover of directors was very small. Most of the cooperatives reported that the majority of the board members had been serving for several years.

The field schedule used in this study did not contain a question relating to the ages of the directors. However, the question was discussed frequently with the managers and all indications pointed to an elderly group of directors. Many of the men who were directors aided in organizing the cooperative. No doubt they were well qualified to fill the positions. However, it seems that some young men should be trained along with this older and more experienced group in order that there will always be a well trained and qualified board. Two associations in particular mentioned that they had elected some young men and that the combination of elder directors and men around the age of thirty years was working very satisfactorily. This suggestion, however, is made without any concrete data to support its validity.

Attendance of Directors and Frequency of Meetings

There seemed to be no direct relationship between the number of directors and the average attendance at the meetings (Table 7). The cooperatives having nine directors had the lowest average percentage attendance at annual meetings. The cooperatives with eleven or more directors had the second lowest average attendance. Cooperatives having only five directors had the highest attendance of their board at the meetings while the cooperatives having seven members on the board had the second best attendance record. The variation in attendance was probably due to distance of travel and convenience to the meeting place. The cooperatives having nine or more directors, usually elected directors from various areas and therefore, the distance that they had to travel probably reduced the attendance at the meetings.

The frequency of meeting by the board of directors fell into two major groups. Twenty cooperatives reported that their board met quarterly while 17 reported that their board met once each month. Three of the associations stated that their board met quarterly and also when special meetings were called. This group had an average of nine meetings per years. One association reported that their directors met only every two years. In this latter case the association was very small and the county agent carried out most of the program of purchasing and handling the supplies of the cooperative. This same association elected its directors for an indefinite time, thus, it would seem to indicate that the association had only a skeleton framework as compared to the other 39 associations.

Table 7. Average percentage attendance of directors at their regular board meetings.

Number of directors of cooperatives	Average percentage attendance
7	85
5	87
9	74
11 and over	81

Electing and Replacing Directors

The method of electing and replacing the directors was about the same in all of the cooperatives studied, with the exception of five. Most of the associations elected their new directors by open floor nominations at the annual membership meeting and required a majority vote of the membership present. Five of the associations had a nominating committee to select several members for board members and present them in the form of nominations. The membership then voted on the names presented and any other person nominated from the floor, and election was determined by a majority vote of membership.

There are arguments both for and against the methods used in electing directors. There is a good possibility of the nominating committee selecting a better qualified board, however, there is also the danger of picking a board that will favor a certain group rather than the membership as a whole.

The practice of picking the directors seemed to be prevalent in one cooperative interviewed. It was reported that the board was cooperative in every respect since they were chosen by the manager and a committee selected by him. This kind of situation may tend to create dissatisfaction among the membership and tend to destroy individual interest and participation in the cooperative if practiced to any great extent.

Theoretically, the election of directors by having a nominating committee is not undemocratic if carried out properly, however, this method in actual practice may tend to place the power in the hands of a relatively small group since in many cases other nominations from the floor will not be made. One association followed the practice of having the committee present two nominees for each vacant position to be filled. That is, if three directors were to be elected, at least six nominations were presented. From these six nominees, three would be elected. This gives a wider choice for the members to select from and would seem to be a better method than by a vote of acclamation.

All associations reported that the old board members were eligible for reelection and a large majority reported that the turnover in board members was relatively small.

Participation of Directors

The participation of the directors in the operation of the cooperative is hard to classify due to the various degrees that would be possible. However, an arbitrary classification was attempted.

One of the cooperatives reported that the board was dominate in all policies and management practices. In this case the manager was considered more or less as a figure-head and was not allowed to instigate any policies on his own initiative.

Twenty-three of the associations reported that the directors were very active and that they either decided the major policies, or that they scrutinized the actual policies and practices carefully. For these 23 associations the managers had freedom of action and were allowed to use their own initiative in developing better policies and practices, but the board observed these carefully and also made frequent decisions themselves.

The remaining 16 associations reported that there was very little activity of the board. In some of these cases the board did establish some of the policies, but on an over-all basis the manager was given full responsibility of almost all phases of policy and of operation. Actually these associations relied very heavily on the manager to take care of the entire program. The managers of the associations which had inactive boards felt that they were having to assume too much of the responsibility and that a more active participation on the part of the board was desired by them. The managers having very active participation from their board were favorable toward this relationship and reported that they actually forced active participation by calling special meetings of the board to pass on certain policies of major importance.

Salaries of Directors

The salaries paid to the board members were based on a per-meeting basis but several variations were prevalent (Table 8).

One point of interest concerning the salaries paid to directors is that there seemed to be no relationship between attendance and the amount of compensation given the directors. The 14 cooperatives that paid no compensation had approximately 85 percent attendance at the meetings of the directors, whereas, the average for the group of 40 was 83 percent. When variations in amounts paid were considered there was still no relationship between the attendance and the amount of compensation paid. For example, the attendance of directors who received five dollars and over and mileage, did not have a higher average attendance than the group who received three dollars per meeting and no money for car expenses.

It is thought that the methods employed in paying directors is explicit in Table 8 and no further discussion on these methods is deemed necessary.

Table 8. Variation in methods employed in paying directors on a per-meeting basis.

Method	Number
Directors receiving $3 and less, no mileage	4
Directors receiving $3 and 5c per mile	4
Directors receiving $4 and no mileage	3
Directors receiving $5 and no mileage	8
Directors receiving $5 and 5c per mile	3
Directors receiving only 5c per mile	2
Directors receiving over $5 and mileage	2
Directors receiving no compensation	14
Total	40

Other Practices Concerning Directors

Directors may be removed from office for such reasons as disloyalty, ceasing to be a member, by vote of the board for any reason, or if they missed three meetings in succession.

The majority of cooperatives reported that only a very small number of young men were elected as board members.

Several of the cooperatives that did not use the staggered system reported that they were in favor of this method for electing members.

All of the associations used the method of one member-one vote to elect their directors.

None of the associations reported that they had ever removed a board member before his regular term expired.

These various policies, practices and relationships of the directors do not make a complete list, but it is thought that they represent the most important ones for consideration.

CHAPTER V

MANAGEMENT POLICIES, PRACTICES, AND RELATIONSHIPS TO THE COOPERATIVES

Length of Service

The number of years that managers were continuously employed had a fairly wide variation (Table 9). Almost fifty percent of the cooperatives had managers who had been with the organization less than three years. This was influenced greatly by the fact that 19 of the cooperatives have been in operation for an average of only three years. Eight of the cooperatives had managers with service records ranging from nine to fourteen years. The average number of years of service for the entire group of managers was almost five years.

Six associations reported having had only the present manager since organization, while only four replacements of managers occurred during the past year of operation.

Table 9. Average number of years that present managers have been employed by the associations.

Length of employment in years	Number
Under three years	17
Three through five years	11
Six through eight years	4
Nine through eleven years	4
Twelve years and over	4
Total	40

Change of Managers

The reasons for changing managers are shown in table 10.

Nine of the fourteen individual managers electing to go into another business actually went into a similar business for themselves. In several cases the previous manager was operating his own business in the same town and was carrying on the same general type of trade as that of the cooperative association.

In five of the associations the business had grown so rapidly in the last few years that it was impossible for the previous manager to handle the larger operations.

One important consideration was that four of the county agents no longer wished to continue acting as the manager of the business and asked that a new manager be hired to take over the operation of the cooperative. It should be noted that this left only three of the group studied with county agents acting as managers of cooperatives. Since this survey was made, one of the three remaining associations has elected a manager, thus leaving only two of the forty under the supervision of the county agents or assistant county agents.

The managers dismissed due to dishonesty made up only ten percent of the total. The dismissal of this group

Table 10. Reasons for changing managers.

Reasons	Number
Individual electing to go into other business	14
Unable to handle the business	5
County agent refusing to serve	4
Dishonest practices	4
Inducted into United States Army	3
Resignation due to not being promoted	2
Retired due to age	1
Died	1
No discharges	6
Total	40

was caused by such practices as embezzlement, switching grades of seed of poorer quality and obtaining the prices for the better grades, etc. These practices were detected quickly and prompt removal of the manager followed.

Training Program

Thirty-three of the cooperatives had no program for training other personnel of the organization to fill a vacancy of the manager's position in case it should occur. The remaining seven did carry on a program of training the assistant manager in all phases of operation of the cooperative. Two assistant managers in this group were being trained under the Veterans Training Program, whereas, the other five assistant managers were being trained by the individual cooperatives without assistance from the Veterans Training Program.

Seven of the thirty-three cooperatives having no training program were actually too small to train anyone, since in four of these cases the manager was the only person employed and in three cases the manager had a part-time secretary as his helper. It seems that the 26 associations having a larger business and more personnel could benefit by training someone to assume the duties of the manager in case an emergency should arise.

Education and Training

The education and experience of the managers employed by the associations was quite varied (Table 11).

There seemed to be no definite pattern of employing managers on the basis of education. Some with college training and some not having such training were employed in the same years. Almost any year considered since 1936 showed that managers might come from any group of training and education. This does not imply that the education of managers is not considered, but it does indicate that the managers were not selected on the sole basis of formal education.

The experience and training of the managers were separated into related and unrelated experience in order to determine to what extent managers were selected on this basis. The related experience was classified as training that was similar to the work in the cooperatives. For example, if a person had been in the merchandising business, this experience was considered as related. If the person had previously been engaged as a truck driver, this was classified as unrelated experience. This breakdown was arbitrary, and it is possible that some were classified erroneously, therefore, the average of both related and unrelated experience was included in table 11.

There appeared to be no definite relationship existing between hiring managers on experience and education. When the groups were divided into those having a high school education and below and those having one year of college or more, the average related experience and the average of both related and unrelated experience was about the same for each group. This seems to indicate that less emphasis has been placed upon education and possibly more on experience.

Salaries of Managers

The salaries of managers had a wide degree of variation, ranging from less

Table 11. Education, training and experience of managers of various cooperatives.

Education	Number	Related experience, average years	Unrelated experience, average years	Average of both
8th Grade and below	7	4.41	6.00	10.14
High School	10	6.50	1.60	8.10
1 year College	7	10.14	4.86	15.00
2 years College	5	2.00	2.40	4.40
3 years College	3	.33	7.00	7.33
4 years College	8	8.12	7.00	15.12
Average	—	6.02	4.52	10.55

Table 12. Number of managers in various salary range groups.

Range in salary	Number	Average salary of groups
Less than $2,000	3	$1,150
$2,000 - $2,999	10	2,421
$3,000 - $3,999	9	3,568
$4,000 - $4,999	7	4,385
$5,000 - $5,999	9	5,385
$6,000 and above	2	6,617
Average	40	$3,862

than $1,000 for the lowest to about $7,000 per year for the highest paid manager in the groups studied (Table 12). Salaries of managers in the group below $2,000 represented the associations that were very small or those that were receiving aid from the county agents. The salaries of the managers in the other groups were not based upon any aid from the county agents since each of these associations had a full-time manager in charge of the program relating to the work of the managers.

Method of Paying Salaries

Several practices of setting the manager's salary were followed by the cooperatives as shown in Table 13.

The cooperatives basing the salary on a flat rate hired the managers for a certain monthly salary and gave no other remuneration. The associations representing the second group gave the managers a salary plus a bonus at the end of the year. For example, a manager would be paid a salary of $300 per month and at the end of the year the directory would declare a bonus of $600, thus, giving him a yearly salary of $4,200. In most cases when this policy was used the flat bonus was voted at the end of the year and usually showed a close relationship to the net margins of the association.

The practice most commonly followed was to pay a manager on a monthly basis plus a fixed percentage of the net margins. As an example of this method, a manager would be paid $200 per month plus ten percent on the net margins. Then, if the net margins were $12,000, the manager would receive a yearly salary of $3,600. When the sliding scale was used a certain monthly salary would be paid, and then supplemented by a sliding-scale bonus based upon net margins. The associations in this group usually gave 20 percent on the first $2,000 of net margins, 15 percent on the next $2,000, 10 percent on the next $2,000, and 5 percent on all over $6,000. There were variations in the percentages given and in the range of net margins in each group. All associations basing the bonus on percentage varied in amounts, ranging from 5 to 25 percent of the net margins.

Table 13. Basis of establishing the salaries of managers of the associations.

Method of establishing salary	Number
Flat rate	10
Flat rate plus flat bonus	9
Flat rate plus 10 percent of net margins	17
Flat rate plus sliding scale bonus	3
Others	1
Total	40

There appeared to be no relationship between the gross mark-up on goods sold and the percentage bonus paid to the managers. The associations paying 20 to 25 percent commissions on net margins had an average gross mark-up of 9.3 percent; those paying 5 to 10 percent commissions had a gross mark-up of 12.5 percent; those paying a flat bonus had an average gross mark-up of 9.3 percent; and those paying no bonus or commission operated on a 9.5 percent gross mark-up. It is believed that the group having an average of 12.5 percent gross mark-up was not due to the commissions paid to the managers, but was caused by an overall higher operating cost. Three of the associations having the highest gross mark-up had recently expanded their facilities and this fact was probably responsible for it.

The sizes of the salaries, however, were related to the commissions paid since the managers receiving a flat salary plus a commission were in most cases receiving the largest salaries.

Salaries and Volume of Business

There was a definite relationship between the salary paid the manager and the volume of business carried on by the association (Table 14). The spread in volume and net margins between the first and second group was small. In the first group some managerial aid

Table 14. Relation of manager's salaries to the volume of business and net margins on operations.

Salary range	Number	Average volume	Average net margins
Less than $2,000	3	$124,747	$ 7,796
$2,000 - $2,999	10	132,055	7,296
$3,000 - $3,999	9	209,019	14,492
$4,000 - $4,999	7	208,136	11,579
$5,000 - $5,999	9	278,956	19,276
$6,000 and over	2	479,610	30,832
Average $3,862	40	$212,568	$ 9,896

was given by the county agent. Probably this was responsible for a larger volume of business than would have prevailed without this aid. In the other cooperative the manager had just been employed and later on he will receive a higher salary if he proves satisfactory.

It is thought that the closeness of the volume of business in the third and fourth range was due to the method of determining the salary. More of the managers who received no bonus were in the salary range of $3,000 - $3,999, and at the same time their volume of business was about equal to the group having a salary range of $4,000 to $4,999. Managers in this latter group received a flat salary plus a bonus.

Salaries and Net Margins

Practically the same relationship existed between salaries and net margins as between salaries and volume of business (Table 14). The difference in the net margins between the third and fourth range seems to be accounted for by the method of determining the manager's salary. In the fourth range most of the salaries were based upon a flat amount plus a percentage bonus of the net margins. In arriving at net margins the percentage going to the manager was considered as expense and would tend to reduce the net margins in the fourth range below the margin of the previous range. Other factors such as education, experience, and the geographic location, would certainly influence the relationship. However, it is thought that the major difference was due to high commissions being deducted before net margins were determined.

Salaries and Experience

There was some relationship between salaries and experience, but the relation did not seem to be as significant as in the preceeding case where volume of business was considered. The extreme cases where managers had 20 to 24 years of experience and received an average of only $2,800, were probably accounted for by geographic conditions and also by the recent hiring of two of the managers. In one case the volume of busines was too small to support a very large salary, since the geographic area was small and was also composed of small-scale farm operators. In the other two cases the managers had been hired on a trial basis and probably will receive raises in salary if their work proves satisfactory. These two associations had volumes of business comparable to associations paying higher salaries to managers, therefore, they will probably raise the present manager's salary.

Table 15. Relation between the salaries of managers and the number of years of experience in cooperatives and other types of business.

Range in years	Average salary	Number
Below 5	$3,691	13
5 - 9	3,539	9
10 - 14	4,013	8
15 - 19	5,312	3
20 - 24	2,800	3
25 and over	4,287	4
Total or average	$3,862	40

Salaries and Education

There appeared to be no consistent relationship between salary and the amount of technical training of the manager (Table 16). One practice influencing this was the fact that, in some cases, the present manager started as an assistant manager and therefore, he had obtained his salary on the basis of experience. Other managers having no experience in some cases were paid on the basis of education, even though this is not shown in the table presented. These cases have to be picked out individually since they do not exhibit themselves when the group is averaged, but it is believed that experience and education

Table 16. Average salaries of managers based upon education.

Education	Number	Average salary
Eighth grade	7	$3,322
High school	10	3,091
One year college	6	4,804
Two years college	5	3,663
Three years college	3	4,191
Four years college	8	4,680
Other	1	800
Total or average	40	$3,862

were used as substitutes for one another.

From the relationships discussed it seems very definite that there was no one factor that was used in determining the salary of an individual manager, but that training, experience, education, geographic location, and length of time in operation, all were interrelated and that each may have had a direct influence on the amount paid the manager.

The volume of business is directly related to the geographic location of the association. For example, a cooperative in one county may not have the potential volume of trade of another county due to different farming practices and different sizes of farm operations. In this case two equivalent managers could not possibly have the same volume of business. Except for variations of this sort it is thought that volume of business and managers' salaries are directly related. It must be recognized, however, that there seems to be no single factor that is used as a basis for determining the salaries of the various managers.

Other Management Practices

On the whole the working relationship between managers and directors appeared to be very good. In only two cases was dissention reported. In 34 of the 40 cooperatives the managers were responsible for handling the personnel of the associations. In three cases this was done by both the manager and board of directors, and in the remaining three the directors were responsible for handling the personnel.

Such service as aiding producers in obtaining credit, suggesting programs for farm improvement, contributing to community funds, putting on various feed tests, etc., were carried on by the managers as extra activities to their job of operating the cooperative association.

CHAPTER VI

GENERAL POLICIES AND PROBLEMS IN THE OPERATION OF THE COOPERATIVES

Accrued Savings

One of the major problems encountered in the operating policy of the cooperatives is the method of handling their accrued savings. The methods employed in designating the equity of the patrons are presented in Table 17.

The use of Book Credits represented by far the most prevalent method employed in accounting for the individual patron's equity. This equity was arrived at by determining first the net margins on total operations. Then each patron's account was credited with the proportion that was due him, based upon the amount of his patronage with the association. For example, if an association had an over-all net margin of eight percent and an individual had purchased $100 worth of goods from the association he would have an accrued equity of $8. This would be credited to his individual account in a ledger kept by the association. Since this account was listed in the Account Book and represented a credit account of the association it is called a Book Credit.

Table 17. Method employed in accounting for the patron's accrued equity in the association.

Method employed	Number
Book credits	31
Issuing stock and book credits	5
Card index	3
Other	1
Total	40

Five of the associations used the method of issuing Preferred Stock to

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members and Book Credits to nonmembers. When an individual's equity was not great enough to purchase a share of stock, a Book Credit or cash payment was made. For example, if the accrued equity of a member was eight dollars and the value of one share of stock was five dollars, then the eight dollars of accrued equity would be accounted for by issuing the individual one share of stock and the remaining three dollars as a book credit, or paid in cash as a direct patronage refund. In most cases the cash payments were made.

Three associations used the Card Index method. This was very similar to the Book Credit method except that the equity accounts were kept on cards rather than in a regular ledger. In these three cases they were in the process of making the change to a regular ledger. The difference in this method and the first method mentioned is actually one of convenience rather than of accuracy.

The association listed as "Other" handled each transaction separately and final settlement was made each time. For example, if 20 farmers placed an order for a carload of supplies, upon arrival of these supplies various charges incurred as expenses for transportation, handling, etc., would be added to the purchase price of the goods and a price per unit established. If this price were $50 per unit, then each individual placing his order would pay $50 for each unit taken by him. By following this procedure no funds would accumulate to the association as an individual unit, thus eliminating any need for a method of accounting for the equity of members.

An organization following the above procedure does not take into account the risk that is involved. If one of the individuals were to refuse to take the supplies ordered by him, the association might not have reserves to take care of this emergency. Also it should be mentioned that this particular association had the lowest volume of business of any of the associations and that it had only handled supplies that were very hard or impossible for the members to get at other local establishments. The manager interviewed stated that the association was organized to obtain the scarce commodities. This factor may be an important consideration since the cooperative may not continue to operate after there ceases to be a scarcity of the supplies in the area.

One further characteristic to be mentioned is that only a very small number of the associations inform their patrons as to the amount of their equity in the association. In all cases, however, any patron may ask to see his equity account, since the books are always open to him. Only five of the associations mailed out letters or cards to the patrons stating the amount of their accrued equity. It was observed that many of the patrons did not understand the meaning of the equity account, since they came in to ask the manager to explain the information on their card or letter. While this would indicate a definite lack of understanding on the part of the members concerning their equity accounts, it also indicates that the cooperatives notifying their patrons of their equity accounts are trying to fulfill their duty and responsibility to their members.

Repaying Equities

A major factor closely associated with the policy of handling equity accounts is the policy of repaying them. The types of plans used are presented in Table 18.

Forty-five percent of the associations had no established policy of retiring the equity of patrons. They reported that this would be decided at a later

Table 18. The policies used by the associations for retiring the equities of members and patrons.

Kind of policy	Number of associations
No policy	18
Revolving-fund plan of (years):	
1	1
3	2
4	1
5	8
6	2
7	5
8	2
Final settlement on each transaction	1
Total	40

date either at the discretion of the board of directors or by a membership vote. The associations that had not established a policy were very young in years of operation, or they were associations that had reorganized due to previous financial difficulty, or they were expanding their facilities to meet the needs of their patrons. Some of those that were increasing their ownership of facilities were associations that had previously been renting their building facilities. They had decided to provide their own accommodations out of accumulated savings.

The associations using the revolving-fund plan had various terms for repayment. The two largest groups were using the five-year plan and the seven-year plan, respectively. An illustration will explain how this method works. If a five-year revolving-fund plan were used, an association starting in 1940 would withhold the accumulated equities through 1945. In 1946 the equities accumulated in 1940 would be paid to the patrons, in 1947 the 1941 equities would be paid, etc., as long as the five-year plan was in effect.

This would mean that the equity accrued over the last five years of operation would be held in equity accounts either as individual Book Credits or as Accounts Payable of the association. The other plans work on the same order except that the terms may be longer or shorter.

One association operating on a one-year plan could not accumulate any equity for future operation since it refunded all of the accrued savings at the end of each year. Unless a strictly cash basis of selling is employed by such an association, it is possible for financial difficulties to arise. The remaining associations followed the practice of making each transaction the final settlement. For example, when a carload of fertilizer was bought, each farmer paid his share of the expenses involved and thus ended the transaction.

Many of the associations are members of a federation which is on a seven-year revolving-fund plan. The individual member associations are on a revolving-fund plan of less than seven years. Due to these differences, the locals may be making cash refunds on equities which they have not received except as issued in the statements of the federation. The following is a hypothetical plan to illustrate how this works. A cooperative on a three-year revolving-fund plan is used. Assuming that the year in question for repayment was 1945 for the individual cooperative, the equities accumulated in 1945 would be paid in 1948. Let us assume further that the accumulated equity on the local operation was $10,000 and the net accumulated equity in the federation was $5,000 for 1945. Now in 1948, the association would pay a total of $15,000 to its members in keeping with its policy. In doing this, the association would pay $5.000 out of its own surplus since it would be 1952 before the federation made the payment of $5,000.

If no financial difficulty were encountered such a practice might work all right as long as the operating capital remained adequate. It should be mentioned that the $5,000 represented a credit to the association. If any undue hardships arose in the federation, or if the federation wished to expand its facilities, the $5,000 in question may be a sunken investment as far as the individual cooperative would be concerned and it might never receive this payment in actual cash. With this fact in mind, there is a great deal of risk involved when a cooperative association pays off on a revolving-fund plan that is shorter than the federation plan in which the association holds a membership.

There is one further practice that adds to the risk of the cooperative which is similar to the above case. This involves the practice of paying the managers a commission based on the net margins of total operations. If, for example, a cooperative has margins of $8,000 on local operations and margins of $4,000 on operations from the federated cooperatives, or total net margins on operations of $12,000, the manager's commission would be based on $12,000. Again this policy involves the practice of making payments out of their local reserves. If financial difficulties should arise in the federation, the local may never receive the $4,000 in the above example.

Establishing the same plan as the federation does not eliminate entirely the problem of repaying equities. A local cooperative may not have a sufficient amount of funds to make patronage payments along with the plan of the federation. If, however, the local associations were to adopt a flexible policy and work downward toward a seven-year plan but never under a seven-year plan, it is possible that the trouble would be largely eliminated as far as patronage refunds were concerned. This plan would not eliminate the problem concerning the payment of the manager's salary based partly on the total net margins. The best way to deal with this problem would be to adopt a regular salary and probably a flat bonus at the end of the year. While this suggestion may destroy individual initiative, it will avoid making payments on the basis of funds that have not been received.

The method of handling non-member's equity was about the same as for members, since all of the associations prorated the accrued savings on the basis of patronage. There was, however, a slight discrepancy in a small number of cases. This occurred in associations that followed the practice of issuing stock or certificates of equity to their members and issued book credits to their non-members. Interest was paid on the first, but in the latter case, it was not. Situations of this type were not general.

Meeting the Desires of the Members

The next factor considered is the various combinations of methods employed in obtaining merchandise desired by the members of the associations. This job was left almost completely to the manager. The ways in which each one went about meeting this requirement or obligation are presented in Table 19.

Table 19. The combination of methods employed in meeting the desires of the patrons.

Methods	Number
Replaced commodities as they were sold	8
Contact with producer and Extension workers	5
Contact with producers only	4
Using past record	4
Taking individual orders, personal contact with producers and Extension workers	3
Taking orders only	2
Extension workers only	2
Other combinations	12
Total	40

The first group reported that they usually replaced commodities as they were sold in order to meet the needs of their patrons. The five associations following the practice of checking with the patrons Extension agents, and other county agricultural workers, tried to stock supplies that the producers requested. These managers kept in close contact with agricultural workers and their programs of work as a basis for meeting the needs of their members. For example, if the county agent were to carry on a pasture improvement program the commodities such as seed, fertilizer, etc., would be stocked in greater quantities.

The third group stated that they contacted their members and tried to stock the commodities which they desired (Table 19). The next group used past sales as an indication of the need and therefore stocked their supplies accordingly.

One group reported that they purchased only on orders placed by the patrons. Two other associations used the Extension information as the sole criterion for future stocking of goods. The remaining twelve associations used various combinations of the above in arriving at the amount of goods to stock each month or each season of the year.

Selling Price Determination

After the goods were purchased and stocked for the patrons the various methods used as a basis for determining the selling prices are shown in Table

Table 20. The method employed in determining the selling price of the commodities as a whole.

Method	Number
Cost and less than 10 percent gross mark-up	5
Cost plus 10 percent gross mark-up	21
Cost and more than 10 percent gross mark-up	3
Prevailing local market price, not above 10 percent gross mark-up	3
Always selling at prevailing local market price	8
Total	40

20. It should be noted that these prices represented an aggregate of all commodities since many were sold on various mark-ups.

Miscellaneous items such as certain sprays, insect power, etc., were marked up as much as 40 percent in many cases, whereas, feed and fertilizer generally had less than a ten percent gross mark-up. In the next chapter the exact gross margins are presented. They conform to the above conditions very closely.

The group following the practice of selling at the prevailing market price did not necessarily sell below the ten percent gross mark-up on the wholesale cost.

The largest group, those that operated on a ten percent gross margin, implied that they preferred to sell at the prevailing market price, but they were unwilling to extract a larger margin. This group represented over 50 percent of the total number of associations included in the study.

Establishment of Prices Paid to the Farmer

Another policy closely related to selling prices was the method of establishing prices paid to farmers for products purchased from them or for service rendered to them. Fourteen used the price prevailing in the local market. Twelve based their prices paid to farmers on both the local market price and the net price in the central market, and gave the higher of the two prices. Ten of the associations reported that they did not purchase products from farmers, but that they acted only as an agent for them and deducted ten percent commission for the services of marketing.

The above practices did not include the handling of cotton. Most of the cooperatives handled cotton only on the basis of putting it into the government loan. A fee ranging from 25 to 50 cents per bale was charged the farmer for performing this service. Throughout the operation of each cooperative the cotton account was kept separate from the accounts of other commodities.

Advanced Price to Producers

The methods of payment for the commodities bought from farmers are presented in Table 21.

The group which advanced full market price actually based their price paid to the farmer on the amount that they could get for the goods less ten percent which was charged to take care of necessary expenses. The group advancing 90 percent reported, that if a price rise enabled them to sell the commodities above the market price of that day, the farmer would receive an adjustment in price. The group advancing no price acted as commission agents for the farmer. His products were sold at whatever price they would bring and the full proceeds less a ten percent commission were returned to him. The group included as "Not related" were the associations carrying on no marketing operations.

In order to treat all patrons as fairly as possible, all marketing and purchasing operations were handled separately, in order that a farmer doing only marketing with the association, for example, would not share in the returns of the purchasing department.

Table 21. The percentage of the purchasing price advanced to the producers at the time of the sale.

Method used	Number
Advanced full market price	20
Advanced 90 percent or less	6
Advanced no price	10
Not related	4
Total	40

Financial Statements

The next factor to consider is the practice relating to the making of financial reports. These reports consisted of operating and of audit reports.

Table 22. The frequency of making operating reports and audit reports among various cooperatives.

Operating reports		Audit reports	
Frequency	Number	Frequency	Number
Monthly reports	36	Monthly reports	0
Quarterly reports	2	Quarterly reports	18
Semi-annual reports	1	Semi-annual reports	15
Annual reports	1	Annual reports	6
No reports	0	No reports	1
Total	40	Total	40

The frequency of making these reports is presented in Table 22.

The policy of making monthly financial reports was practiced by 90 percent of the cooperatives. The reason for this high percentage was probably due to the close supervision by the auditing division of the Mississippi Federated Cooperatives (AAL). This statement is partially supported by the fact that practically all of the associations which were members of this Federation, reported that they made out their reports monthly. Most of the managers making monthly reports thought that it was essential for good business operations. Three managers reported that the monthly statements were burdensome and time consuming.

One association made only an annual report. It carried on a relatively small business and, over a period of several months there were only a very small number of transactions.

The practice of making audit reports was fairly uniform for most of the associations, since a large majority either made quarterly audits or semi-annual audit reports. Six associations reported that only one audit was made each year. The associations not having an audit reported that a list of all transactions was kept, but that a condensed report was not made. Most of the associations making quarterly audits and semi-annual audits were members of the Mississippi Federated Cooperatives (AAL), and were checked by auditors of the Federation. This probably accounted to a large extent for the frequency of these reports.

Most of the managers were very favorable toward the policy of having frequent audits, since it gave them an opportunity to have expert advice on handling financial problems involved in the operation of cooperatives. Some of the managers reported that these frequent checks aided them in keeping their inventories from going too high, in pointing out dangers of high accounts receivable, and in serving to show them the condition of the business from time to time. The majority of the managers were well agreed that monthly financial statements and quarterly audits were the best policy. These reports pointed out various difficulties early so that they could be corrected before it was too late from the standpoint of sound business operations.

Use of Financial Statements

After the operating statements were made they were used by the managers and the board members, but were not distributed to the membership. This same practice was followed to a large extent with audit reports. The annual audit was the only one presented to the members in any form. Since it was read at the meeting, it is very doubtful that the membership was able to gain very much information from it concerning the operation of the cooperative.

A very small number of associations supplemented the reading of the annual report with visual aids. As an example of the use of visual aid the following form is presented.

Total Volume of Business $________
Total Expenses - - - $________
Total Cost of Goods - $________
Your Margins - - - $________

Table 23. Method of informing the members of the annual audit report.

Method	Number
Sent members a copy of the report	6
Read report at the annual meeting	21
Office copy open to members	2
Published report in paper	1
Sent the executive committee a copy	1
No method of presentation	9
Total	40

Posters similar to the above were prepared on large pieces of white cardboard with the information entered in large letters. Each item was explained to the members by the presiding officer. It is thought that the audits can be made of great use to the membership if they are presented adequately, but are of very little benefit if they are only read at the meeting.

Credit Practices and Policy

The policy followed in offering credit and aiding farmers in obtaining credit had several variations. There were five associations that were operating on a cash basis. The remaining 35 associations extended credit to their patrons for a period of 30 to 90 days. The 30-day credit extension was most prevalent.

Besides extending credit, 13 of the managers reported that they aided their patrons in securing credit by suggesting that they go to the Production Credit Associations or to the commercial banks for a loan. The difficulties encountered in the credit policy will be more explicit in the section covering the current ratios.

CHAPTER VII

A COMPARISON OF THE FINANCIAL RATIOS OF THE VARIOUS COOPERATIVES

The method of ratio analysis is used to present a description of the actual operations of the cooperatives from a business point of view. A cooperative may have some objectives that are not comparable to other types of business organizations, but they have many characteristics which are comparable in economic operations. An attempt is made through ratio analysis to point out the cooperatives that seem to be following the best operating policies, based upon their position relative to the average ratio for the group. Pertinent reasons for the variations in ratios among the different cooperatives will be presented. None of the ratios should be used as the sole criterion, therefore, the limitations of each will be recognized. Since data for three years were used in calculating the ratios, it appears that increased dependence may well be placed upon their use in this study.

Current Assets to Current Liabilities

This ratio is obtained by dividing the current assets by the current liabilities. and is usually referred to as the current ratio. It is used extensively because it is a good indicator of the ability of the business to meet its current debts as they come due. It applies to a specific time and may not be adequate as a sole criterion, since the financial conditions of a cooperative may undergo sharp changes within short periods of time.

Table 24. Ratio of average current assets to average current liabilities for the various cooperatives, 1946-48.

Cooperatives	Range of ratios	Average of the range
Upper fourth	33.7:1 to 8.6:1	16.5:1
Second fourth	7.5:1 to 2.7:1	4.4:1
Third fourth	2.6:1 to 1.5:1	1.8:1
Lower fourth	1.5:1 to .8:1	1.1:1
Entire group	33.7:1 to .8:1	1.9:1

The nine cooperatives in the upper fourth had total current assets of $229,796 compared to current liabilities of $13,947, or an average ratio of 16:1. The lower fourth had total current assets of $465,493 compared to $409,195 of current liabilities, or a ratio of 1.1:1. The ratio for the other two groups fell within the ranges of the lower and the upper groups and in about the same proportion (Table 24). This indicates that the associations having the larger current assets had a tendency to let their current ratio drop lower than did the associations with a smaller amount of current assets.

All of the associations in the lower fourth seem to be in a vulnerable position. If they were required to liquidate their assets in order to pay their liabilities at once, they would be left with a very small amount of operating capital, which would most likely reduce their efficiency of operation.

Actually, there were 13 cooperatives that were below the average for the group as a whole. If the cooperatives having less than the average ratio for the group were only in this situation temporarily, it is possible for them to be operating on a sound basis. But if their current ratio was continuously low, then action should be taken to reduce the liabilities and build up the current assets in order to give them sufficient capital for economical operations. It is generally recommended that the current ratio should never fall below a ratio of 2:1.

One other point to consider is that several of the cooperatives in the lower fourth had a large amount of accounts receivable on their books. This makes their position even more precarious since they could not possibly meet their liabilities until they collected these outstanding accounts or borrowed more money. Resorting to either of the above ways for correction would not keep the association from being in an unfavorable financial position.

One limitation to the adequacy of the current ratio is that it is possible for a cooperative to build up a large inventory which will make the ratio appear favorable. This favorable appearance is deceiving since the stock may not move quickly. To the extent that the inventory is built up too high, or reduced too low, the value of the current ratio, as a guide, is reduced. It is not known to what extent the practice mentioned above might have been followed. If the cooperatives were in the high ratio group because they had built up a large inventory their position would not be as good as was indicated in Table 24. This would be especially true if the goods included in the inventory were relatively slow to move.

The cooperatives in the upper fourth may also have been following the practice of holding too much of their funds in cash reserves. The cooperatives having a ratio above 30:1 probably were not using their capital enough and a large amount might be idle. To the extent that capital is idle the favorableness for efficient operation is reduced even though the ratio may appear to be favorable.

The use of current ratio is of tremendous importance as one of the fundamental guides in business operation even though there are some limitations prevalent.

Accounts Receivable to Current Assets

This ratio is used to show the amount of capital tied up in accounts receivable and it tells a great deal about the credit policy of the cooperative. A large figure for current assets may not mean much toward economical and efficient operation of a cooperative if a high percentage is in accounts receivable. To have a large proportion of the current assets in accounts receivable results in a small amount of capital available for operating or working capital. If the operating capital is reduced to a low amount the advantages of cash purchases and volume buying cannot be realized. The readiness of capital is an important factor in operating a cooperative, therefore, the use of this ratio deserves attention.

The associations in the lower fourth (Table 25) had an average of almost 50 percent of their current assets tied up in accounts receivable, compared to about six percent for the nine cooperatives in the upper fourth.

A further check indicated that the cooperatives in the lower fourth had been purchasing goods on a time basis and that they were paying three percent interest on the funds. In contrast, the group of cooperatives that had a very small amount of accounts receiv-

Table 25. The percentage that average accounts receivable were of average current assets of various cooperatives, 1946-48.

Cooperatives	Range in percent	Average percentage
Upper fourth	3 to 12	6
Second fourth	12 to 20	16
Third fourth	20 to 35	27
Lower fourth	35 to 64	48
Entire group	3 to 64	30

able were borrowing only in the peak season. The cooperatives in the upper fourth actually loaned money during the major part of the year for which they received three percent interest. From these facts it is evident that the cooperatives selling a large amount of goods on credit were having to pay out interest, thereby reducing their savings for the members. The cooperatives with little or no accounts receivable could utilize their money to restock and at the same time avoid the interest payments that were prevalent with the cooperatives having a high percentage of their funds in accounts receivable.

It was also found that the cooperatives in the lower fourth had been losing money on the acounts receivable which resulted in an over-all reduction in savings. With these losses on debts occurring, the members paying cash for their goods were actually paying the bad debts of others out of their would-be savings. With interest on borrowed money and loss due to bad debts the patrons purchasing on a cash basis were being doubly penalized. Even though the losses were not severe, in some cases there seemed to be little justification for cooperatives tying up approximately one-half of their current assets in accounts receivable.

One further danger of the large accumulation of a high percentage of operating funds in accounts receivable is that should credit become tight, the cooperatives might have difficulty in obtaining sufficient capital for operations.

One precaution in using this ratio as a measure is that it is possible for an association to have a very small amount of capital in accounts receivable but to have a large inventory composed of slow-moving goods. This possibility, however, does not seem to be to important in this study, since most of the associations included were handling commodities that were very similar and comparable. This tends to strengthen the use of accounts receivable to current assets as a guide. In terms of the group as a whole there was little doubt but that the associations falling below the average should try to improve their position. There were six cooperatives having more than 40 percent of their current assets in accounts receivable. These six should definitely strive toward a lower ratio.

Net Margins to Current Liabilities

In order to determine this ratio the net margins were divided by the current liabilities. The significance of this ratio is that it tends to show the earning power of an association compared to its current debt. In simple terms the ratio means that if a cooperative's net margin is high and its current liabilities are low, it is more successful than an organization having characteristics just the opposite.

There are, however, at least two dangers in the above assumption that must be considered in making an adequate appraisal of this ratio. The following example is given to show why it is necessary that precautions should be taken in the evaluation. If one cooperative followed the policy of selling on a two percent margin compared to another association that was selling on a 15 percent margin, then the ratio of the organization selling on the low margin would have to be smaller than the other, yet it might be just as successful as the association operating on the 15 percent margin. The other precaution to consider is that credit sales will increase net margins just as do cash sales. This will give a higher ratio but in effect will not be nearly as dependable from an economic point of view. If these conditions are known, then the validity of the ratio can be better appraised. In this study these factors are considered and will be discussed later in this section.

The cooperatives in the upper fourth (Table 26) had total net margins of $94,926 compared to $15,727 in current liabilities, or an average ratio of 6:1. The associations in the lower fourth had a total of $92,626 in net margins compared to $405,278 in current liabilities, or an average ratio of .2:1. This denotes a significant difference in the earning power of these two groups, especially since the total net margins

Table 26. Ratio of average net margins to average current liabilities for the various cooperatives, 1946-48.

Cooperatives	Range of ratio	Average of range
Upper fourth	9.3:1 to 3.0:1	6.0:1
Second fourth	2.8:1 to 1.1:1	1.6:1
Third fourth	1.1:1 to .4:1	.6:1
Lower fourth	.4:1 to .0:1	.2:1
Entire group	9.3:1 to .0:1	.6:1

for the two groups were nearly the same amount. Furthermore, the cooperatives in the lower fourth followed the policy of selling at higher prices than the cooperatives in the upper fourth. In checking the gross margins, or the gross mark-up on the goods sold, it was found that the associations in the lower fourth had an 11 percent mark-up compared to 9.5 percent for the upper fourth. Thus, the influence of low selling prices could not be the reason that caused these nine cooperatives to be in an unfavorable position.

In considering the second precaution concerning the validity of use of this ratio, a check was made on the credit policy of the two groups. It was found that the lower fourth actually sold more goods on credit than did the associations in the upper fourth. Six of the nine associations in the lower fourth actually fell in the lower fourth based on the ratio of accounts receivable to current assets, while only one of the nine associations in the upper fourth was in the same group. Five of the associations in the upper fourth were also in the upper fourth in the ratio of accounts receivable to current assets. This makes it improbable that the net margins were high due to large credit sales.

Since the two precautions listed previously were considered in determining the validity of the ratio of net margins to current liabilities as a basis of the cooperative's earning power, it is evident that associations in the lower-fourth group should strive to increase their efficiency in order that they may be able to make returns similar to the upper fourth.

Net Margins to Total Assets

The ratio of net margins to total assets offers the possibility of comparing the earning power based upon capital invested. There are, however, many variables such as differences in management, in location, in services rendered, and in selling prices, that influence the earning power for various organizations. Since this is true, use of the above ratio as a guide is limited.

Total net margins for the group as a whole were $356,252 compared to total assets valued at $2,340,057, or an average ratio of .15 to 1 (Table 27). For the 36 cooperatives considered, out of each dollar invested in capital assets 15 cents in net earnings were realized. Twenty-four of the cooperatives were above the average in their earning capacity based upon capital investment. The cooperative with the highest ratio earned 35 cents for each dollar invested, or a net margin of $9,281 from a total of $26,251 invested in total assets. The cooperative with the lowest ratio earned only $5,680 from an investment of $80,619 or seven cents per dollar invested in capital assets. The cooperatives in the upper fourth earned an average of 26 cents for each one dollar invested, or a total of $86.972 in net margins with $323,543 invested in capital assets. In contrast, average earnings, of only eight cents per dollar invested, or a total of $86,790 in net margins to $1,030,976 in total assets were realized by the nine cooperatives in the lower fourth.

It appears that the cooperatives making the highest net earnings were also the ones that had the smallest amount invested in capital assets.

The second fourth had total net earnings greater than those for any other group, however, there were two very large cooperatives with high net earnings in this group that seem to be responsible for the total net margins being higher. Only three cooperatives in

Table 27. Ratio of average net margins to average total assets for various cooperatives, 1946-1948.

Cooperatives	Range of ratios	Average of range
Upper fourth	.35:1 to .23:1	.26:1
Second fourth	.22:1 to .18:1	.21:1
Third fourth	.18:1 to .12:1	.16:1
Lower fourth	.11:1 to .07:1	.08:1
Entire group	.35:1 to .07:1	.15:1

Table 28. Average net margins compared to average total assets in dollars for the various cooperatives, 1946-1948.

Cooperatives	Total net margins	Total assets
Upper fourth	$ 86,972	$ 323,543
Second fourth	102,731	487,714
Third fourth	79,759	496,770
Lower fourth	86,790	1,030,976
Total for group	$356,252	$2,340,057

Table 29. Ratio of average purchases by patrons to average accounts receivable for the various cooperatives, 1946-1948.

Cooperatives	Range	Average of range
Upper fourth	293:1 to 61:1	105:1
Second fourth	59:1 to 34:1	44:1
Third fourth	28:1 to 18:1	22:1
Lower fourth	13:1 to 1.5:1	6:1
Entire group	293:1 to 1.5:1	16:1

the upper fourth and the second fourth combined had over $50,000 invested in capital assets, compared to 13 cooperatives in the third fourth and lower fourth group combined that had over $50,000 invested in total assets (Table 28).

For the group as a whole it is evident that the smaller associations had maintained a higher rate of earning on investment than had the cooperatives having larger total assets. Since the cooperatives having a lower investment were showing better net earnings or more savings to the patrons, it is probable that some of the cooperatives in the lower fourth have over-expanded, or that they were not using the facilities as efficiently as they should. It is possible that some of the associations have invested in some types of equipment such as seed cleaning, cold storage, etc., in order to give a service which had not been offered previously, and as a result operate this equipment on a break-even or below-cost basis. This type of service cannot be measured in dollars and cents and therefore, a cooperative may have an unfavorable ratio and still be performing a much desired service. In the majority of cases the operation of the various cooperatives were comparable, due to their similarities in services rendered. There were, however, some few exceptions existing and they must be considered in reaching a valid conclusion.

Purchases by Patrons to Accounts Receivable

The ratio of purchases by patrons to accounts receivable is used to indicate the credit policy of the organization. If the accounts receivable are large in proportion to the amount of sales, then it is indicative of a more liberal credit policy than when the accounts receivable are low in proportion to the total sales. This ratio also shows something of the amount of capital tied up in accounts that may reduce the amount of working capital.

The purchases by patrons compared to the credit granted by the association ranged from $293 for the cooperative with the highest ratio, to only $1.50 for the cooperative with the lowest ratio (Table 29).

The nine cooperatives in the lower fourth had an average of six dollars in sales per dollar of credit, whereas, the nine cooperatives in the upper fourth had $105 of sales per dollar of credit. There appeared to be no relation between the size of business and the favorableness of the ratio, since the total volume of sales for the lower fourth was 1.5 million dollars compared to 1.3 million dollars for the upper fourth. The second fourth had an average of $44 of sales per dollar of credit and 1.3 million dollars in sales. For the nine cooperatives in the third fourth the sales were $22 per dollar in credit with a total of 1.7 million dollars of sales.

A further check was made among several of the largest and of the smallest cooperatives to determine whether or not volume of sales and the credit policy were related. High ratios were found in both the large and the small cooperatives so there seemed to be no definite relationship. Various area breakdowns were checked to see if there might be some relationship due to geographic location. The only point that seemed significant in this classification was that the cooperatives with the lowest ratios were located in the Delta area and in areas where dairying was carried on extensively. The associations in this area reported that their credit policy was 30 to 60 days due to the nature of business, especially in the dairy sections where farmers usually paid for the goods bought on a monthly credit basis. If this practice is followed it is possible that the ratio would naturally be lower than for cooperatives that did not follow a similar policy. It is also possible that some of the cooperatives made a collection drive previous to the end of the fiscal year in order to get their accounts receivable down to the very minimum, and by so doing, increased the favorableness of their ratio.

In making an evaluation of the credit policy based upon the ratio of purchases by patrons and accounts receivable the precaution relating to the end of the year collection campaigns must be considered as a possible influence on the favorableness of the ratio.

Fixed Assets to Total Assets

This ratio is determined by dividing the fixed assets by the total assets. It is used to show the proportion of the total assets that are invested in fixed or non-liquid assets. The amount of funds in fixed assets gives an indication of the overhead expenses of the association. This particular ratio has its limitations and especially in a study of cooperative organizations, since some of the associations maintain a part of the facilities in fixed assets in order to render a service to their members. When this is taken into consideration, it may be quite possible for a cooperative to have a very low ratio, but at the same time be neglecting an investment in a much needed service. If, on the other hand, an over-investment is made in fixed facilities, there is less money available for operating purposes.

The variation in the percentage of total assets invested in fixed assets was from one to 61 percent. The average percentage invested in fixed assets for the upper fourth was four percent, compared to 46 percent for the lower fourth. Neither of these extremes were the most desirable, since the group having the very low percentage invested in fixed assets was not offering as many services as the cooperatives in the lower fourth (Table 30). Also, the cooperatives in the upper fourth were, in some cases, renting part of their assets, such as buildings and lots, and therefore, their ratios appeared much more favorable. The funds spent for rent were included as an expense. This practice tended to reflect a more favorable ratio. Thus, cooperatives renting their facilities, actually were not as favorable as they appear in Table 30.

The ratio of the nine cooperatives in the lower fourth is somewhat misleading since several of them had expanded rapidly in the past three years, by building new buildings, putting in seed-cleaning equipment, purchasing trucks, and other fixed equipment. It seems evident that these cooperatives were rendering more services by these recent expansions even though their raito placed them in the lower fourth. Also the cooperatives that have expanded in the last few years have not had sufficient time to depreciate their assets as have those in the upper fourth.

Since the most and the least favorable ratios have been presented and reasons given for the position of each, it is possible that the average provides a better guide in this comparison of total assets to fixed assets. The third fourth listed in Table 30, approached the average for the 36 cooperatives closer than any other group. This group was composed of cooperatives that offered about the same type of services and, at the same time, the facilities used were owned by the members. This would tend to eliminate the effect of renting facilities and also the effect of recent expansion, and would tend to be a more representative figure to be used as a guide.

Table 30. Ratio of average total assets to average fixed assets for the various cooperatives, 1946-1948.

Cooperatives	Range of percentage	Average of range
Upper fourth	1:1 to 7:1	4:1
Second fourth	8:1 to 15:1	11:1
Third fourth	16:1 to 27:1	20:1
Lower fourth	28:1 to 61:1	46:1
Entire group	1:1 to 61:1	28:1

Cost of Goods Sold to Merchandise Inventory

The main value of this ratio is to indicate the rapidity of the association's annual inventory turnover. This gives a good clue to the use that is made of the capital for operating purposes. If the ratio is high then it is indicative that the capital is working. A low ratio shows that the cooperative is handling slow-moving goods, or that a large amount of capital is tied up in inventory. This ratio is determined by dividing the cost of goods sold by the merchandise inventory.

The cooperatives in the upper fourth had an average annual turnover of 29 times, with the highest turnover being 69 times (Table 31). Nineteen of the cooperatives had an average annual turnover within the range of 12:1 to 20:1, with the greatest concentration in the range of 12:1 to 14:1.

This ratio may be influenced a great deal by the cooperatives' operations. Some cooperatives make an effort to reduce their merchandise inventory to a low figure at the end of the year. This practice tends to show a very favorable inventory turnover. To take out this influence monthly inventories would be more accurate and provide a better guide in determining the rate of turnover. Even though this monthly ratio was not obtained, it appeared that the cooperatives having high ratios were using their capital more efficiently than the nine cooperatives in the lower fourth (Table 31). It is possible, however, that the cooperatives in the upper fourth were following the practice of not stocking an adequate amount of goods for their patrons, while showing a very high ratio at the same time.

Table 31. Ratio of average cost of goods sold to average merchandise inventory for the various cooperatives, 1946-1948.

Cooperatives	Range of ratios	Average of range
Upper fourth	69:1 to 21:1	29:1
Second fourth	20:1 to 15:1	17:1
Third fourth	14:1 to 12:1	13:1
Lower fourth	10:1 to 4:1	7:1
Entire group	69:1 to 4:1	12:1

Table 32. Ratio of average gross margins to average gross purchases by patrons for the various cooperatives, 1946-1948.

Cooperatives	Range of ratios	Average of range
Upper fourth	5:1 to 8:1	7.7:1
Second fourth	8:1 to 9:1	8.3:1
Third fourth	9:1 to 10:1	9.6:1
Lower fourth	10:1 to 20:1	16.5:1
Entire group	5:1 to 20:1	10.5:1

Gross Margins to Gross Purchases

This particular ratio is most important in an indirect way. If a cooperative followed the practice of selling on a very low gross margin then this factor would influence the other business ratios, especially the net margin figure. In order to show the general policy of selling by the various cooperatives and to incorporate the influence of this ratio on other ratios, it is presented in Table 32.

Of the 36 cooperatives studied, 28 operated on a range of seven to ten percent gross mark-up. Only one cooperative operated below seven percent, and only seven had a mark-up above ten percent. There were 18 cooperatives in the two middle groups that had only a two percent difference (Table 32). Since so many of the associations made about the same percentage mark-up on their goods to determine the selling price, it appeared that the low net margin for the lower group was for some other reason. The similarities in mark-ups seemed to strengthen the validity of the assumption made previously concerning the ratio of net margins to current liabilities. This same reasoning strengthens the assumption that will be made later where the net margins are related to total volume of business.

Operating Expenses to Total Volume of Business

This ratio reflects operating expenses as a percent of the total volume of business. Operating expenses include the major items of salaries and wages, depreciation, rents, salaries and expenses of directors, and taxes. This ratio not only gives the overall operating costs compared to total volume, but it is useful in connection with other ratios,

Table 33. Ratio of average total operating expenses compared to the average total volume of business for the various cooperatives, 1946-1948.

Cooperatives	Range of ratios	Average of range
Upper fourth	.024:1 to .057:1	.038:1
Second fourth	.058:1 to .072:1	.064:1
Third fourth	.073:1 to .086:1	.080:1
Lower fourth	.094:1 to .167:1	.116:1
Entire group	.024:1 to .167:1	.075:1

especially those showing the percentages of each operating expense compared to the total operating costs.

An average of 7.5 cents out of each dollar of business was incurred as operating expenses for the cooperatives as a whole, with a range from 2.4 cents for the most favorable to 16.7 cents per dollar of business for the least favorable association (Table 33). The upper fourth spent an average of 3.8 cents for each dollar of business compared to an average of 11.6 cents for the lower fourth.

Twenty out of 36 cooperatives operated on a ratio above the average while the remaining 16 were below the average. Only three cooperatives had an operating expense above 11 cents for each dollar of business. The second and third groups were very close to the average and the 18 cooperatives in these two groups had a spread of only three cents per dollar volume of business. The range for the upper fourth and the lower fourth was wider, being three cents and seven cents per dollar of volume, respectively, (Table 33).

There seemed to be no consistent relation between the volume of business and total operating expenses (Table 34).

The nine cooperatives in the upper fourth had an average volume of business of $233,755 compared to $246,239 for the lower fourth. The operating expenses were $8,772 and $28,630, respectively. Indications were that the larger cooperatives were either very efficient or very inefficient. The second fourth and third fourth had both total volumes and total operating expenses that were almost the same.

Table 34. A comparison between the average operating expenses and average volume of business for the various cooperatives, 1946-1948.

Cooperatives	Average operating expenses	Average total volume
Upper fourth	$ 8,772	$ 233,755
Second fourth	12,169	189,942
Third fourth	13,742	172,279
Lower fourth	28,630	246,249
Average	$ 15,289	$ 210,556
Total	$569,831	$7,580,034

The cooperatives in the lower fourth had a great deal of influence on the average of the entire group. Twenty-seven cooperatives were below the average for the entire group. This indicates that the lower fourth was not as favorable as was shown in Table 34, since nine cooperatives influence the average so much.

Salaries and Wages to Gross Volume

The purpose of this ratio is to measure the efficiency of the personnel of the organization rather than the size of the individual's salary, or the number of employees working in an association. This ratio indicates the amount spent for salaries and wages for each dollar of business carried on by the association. It also shows the percentage of the total gross income used in paying salaries and wages. The ratio is determined by dividing the amounts paid out in salaries and wages by the gross volume of business of the association.

In this analysis money paid to directors was excluded, but commissions paid to managers and other employees were included in salaries and wages. Total gross volume included all the business carried on by the cooperative, including both purchasing and marketing activities.

The cooperatives with the least expenditure for wages and salaries on a per dollar basis spent less than 1 cent for each one dollar of business. The cooperative with the highest expenditure for wages and salaries spent 6.9 cents for each dollar of business. The nine cooperatives in the upper fourth had a range from less than one to 1.7 cents, or an average of 1.2 cents, for each dollar of business. In contrast, the nine cooperatives in the lower fourth had a range from 3.2 to 6.9 cents, or an average of 4.3 cents, for each dollar of business (Table 35). Twenty-

Table 35. Ratio of average expenditure for salaries and wages to the average total volume of business for the various cooperatives, 1946-1948.

Cooperatives	Range of ratios	Average of ratio
Upper fourth	.007:1 to .017:1	.012:1
Second fourth	.018:1 to .023:1	.020:1
Third fourth	.024:1 to .031:1	.026:1
Lower fourth	.032:1 to .069:1	.043:1
Entire group	.007:1 to .069:1	.026:1

four of the 36 cooperatives had a ratio of less than the 2.6 cents per dollar volume of business.

The association having the highest ratio had the smallest volume of business, whereas, the cooperative with the lowest ratio had the largest volume of business. The six largest associations spent 2.4 cents in salaries and wages out of each dollar of business compared to 3.6 cents for the six cooperatives with the smallest volume of business.

The second fourth had an average of $164,477 volume of business compared to $3,377 in salaries and wages, or an average ratio of .02:1. The third fourth had an average volume of business of $196,506 compared to an expenditure of $5,182 for salaries and wages, or an average ratio of .026:1. This relationship is not consistent with the one that existed between the six largest and the six smallest cooperatives compared previously. This indicates that factors other than size of business also affect the proportion spent for salaries and wages. It is possible that some of the new managers were not receiving a salary as high as those who had been employed for a longer time. Thus, the cooperatives operated by new managers would have a more favorable ratio. The managers' salaries in these associations constituted a relatively large percent of the salaries and wages expense.

It is possible that some of the cooperatives have a large volume of business due to their location in a favorable trade area and at the same time pay about the same salary for their manager as was paid in less favorable areas. This would tend to influence their ratio. Even though this influence may have been prevalent, this reason alone was not adequate to explain the variations existing between salaries and wages when compared to total volume of business.

Net Margins to Total Volume

The use of this ratio compares the earnings of the association to the total volume of business. If associations have comparable pricing and credit policies, the ratio of net margins to total volume is an excellent guide in showing earning efficiency. The pricing policies of the cooperatives were very similar, since a majority of them followed the practice of a ten percent gross mark-up. This practice strengthens the use of the ratio of net margins to total volume of business. There were, however, a few of the cooperatives that followed either a higher or lower gross mark-up than the majority. Consideration will be given to these differences in the following comparison. Consideration will also be given to the credit policies of the associations in evaluating the comparison of the earnings for the various cooperatives.

The nine cooperatives in the upper fourth had a range from 9.6 cents to 6.6 cents, or an average of 7.7 cents, in net margins per dollar of business (Table 36). The lower fourth only realized 2.2 cents in savings per dollar of business. This difference in earnings for the upper fourth and the lower fourth was not too significant due to their pricing system. Those in the lower fourth had an average gross mark-up of 8.4 percent compared to 11.8 percent for the upper fourth. This gives a difference of 3.4 percentage points between the two groups. This partially offsets the difference in the average ratio of 5.5 percent in the comparison of net margins to total volume. From these computations a difference of 2.1 percent in the earning efficiency was prevalent after variation in the pricing policy was considered. The spread in the average ratio for the second fourth and the third fourth contained differences in the pricing policy of one percent, being 10 percent and 9 percent gross mark-up, respectively. After accounting for the influence of this price policy, there was a difference in efficiency of .8 of 1 percent in these two

Table 36. The ratio of the average net margins to the average total volume of business for the various cooperatives, 1946-1948.

Cooperatives	Range of ratios	Average of range
Upper fourth	.096:1 to .066:1	.077:1
Second fourth	.065:1 to .052:1	.060:1
Third fourth	.045:1 to .032:1	.042:1
Lower fourth	.031:1 to .005:1	.022:1
Entire group	.096:1 to .005:1	.047:1

groups. Consequently differences in the earning power of the associations was not as great as indicated in Table 36.

The upper fourth had a more favorable credit policy than the nine cooperatives in the lower fourth. The accounts receivable were 23 percent of the current assets for the upper fourth and 27 percent for the lower fourth. The credit policy for the second fourth and third fourth was almost the same. By analyzing the effect of the credit policy and the pricing systems for the various groups there was definitely a difference in the earning efficiency of the various cooperatives.

There was some relation between the size of the business and the net margins of the various cooperatives. Those having a volume of business over $300.000 were in either the upper fourth or the lower fourth. The largest association, which had a volume of more than $700,000, was third from the bottom in its earning efficiency. On the other hand, the second most efficient cooperative had a total volume of $455,000. The associations making up the lower fourth had a larger average volume than any other group (Table 37). The second fourth had the smallest average volume of business, yet their net earnings were second, (Table 37). With the exception of the upper fourth the net margins seemed to be smaller as the average volume of business increased. Two large associations with a very favorable earning ratio were in the upper fourth and influenced the average volume.

Table 37. A comparison of the average net margins and the average total volume of business for the various cooperatives, 1946-1948.

Cooperatives	Average net margins	Average volume of business
Upper fourth	$ 16,096	$ 210,259
Second fourth	9,177	152,901
Third fourth	8,313	212,132
Lower fourth	5,797	266,923
Group average	$ 9,896	$ 210,556
Group total	$356,252	$7,580,034

The services offered should be considered in the evaluation of this ratio. If a cooperative is furnishing seed-cleaning equipment, cold storage services, etc., of a break-even basis, then a less favorable ratio will result. Apparently this was true in two or three cases, but the majority of the associations were similar in the type of services offered, their pricing policies, and their credit policies. Due to similarities among most of the cooperatives, the differences in the earnings figures were probably due to the over-all efficiency in their operations.

CHAPTER VIII

SUMMARY

Cooperatives covered in this study were organized or reorganized in two specific periods, 1934-1938 and 1944-1949. About one-third had been reorganized since their original charter was granted. The original organization of cooperatives was carried out by county agents and farmers working together in 55 percent of those studied.

The funds for organization expenses for the cooperatives were obtained from farmers in over 50 percent of the cases studied. Other agencies paying for the organization expenses included the Farm Bureau Federation, county agents, Mississippi Federated Cooperatives (AAL), Farmers Home Administration, and Tennessee Valley Authority. None of these agencies represented a large percentage of the total studied.

Most of the money used for original investments was obtained from accumulated savings, and by issuing certificates of indebtedness. The organizations using accumulated savings usually rented facilities until enough funds from operations could be built up to enable expansion. In 20 percent of the cases funds were obtained by issuing certificates of indebtedness. The other sources of funds were direct loans from agencies other than the farmers themselves. The methods of financing by accumulated savings and the issuing of certificates of indebtedness tended toward a more complete ownership by members. It is probable that this sense of self-ownership is important in the operation of an association, because it is likely that the members who have an investment in an association will probably patronize it.

Most of the cooperatives had to borrow operating capital during each year's operation, especially during the peak seasons just before crops were planted and during the harvest season. The local cooperatives that were members of the Mississippi Federated Cooperatives (AAL) obtained credit by buying goods through this organization on a monthly credit basis. Other cooperatives that were not members of the federation obtained their funds from other local cooperatives, the Bank for Cooperatives, and commercial banks.

The cooperatives studied had an active membership of about 1,600 per association. There had been a gradual increase in membership each year since the associations were started. The policy used in determining membership in the associations was based upon an application of the patron to become a member and the acceptance by the manager or the board of directors. Some associations considered all patrons as members, and seven of the associations required a membership fee of one dollar. Having the prospective member sign a membership application was the most prevalent method used. Upon becoming a member each person was allowed one vote on matters pertaining to the operation of the association.

The attendance of members at annual meetings averaged about 20 percent for the entire group of cooperatives studied. Fourteen of the associations had less than an average of five percent of their members present. The associations having 50 percent or more of their active members as landowners and those giving annual barbecues and picnics had the highest percentage attendance of their members at the annual meetings. A good attendance at the annual meeting is essential for the best operation of a cooperative, since it seems logical to expect a better informed membership to patronize the association and to see that the association best meets their needs.

Informing members about the operation of the cooperatives was carried on by annual meetings, personal contact, periodicals, field service demonstrations and individual news letters. An annual meeting was the method mentioned most frequently as a means of informing members. Since the meetings were only about two hours long and were held only once each year, it is doubtful that the job of informing members about the operation of the business was accomplished very successfully.

The number of directors in each association varied from five to eighteen, with about 75 percent of the associations having seven directors. The term of office for the directors was two years. In most cases the staggering method of election was most prevalent. The associations following other methods of election were not taking advantage of the safeguard offered through the use of the staggered method of election.

The attendance at the directors' meetings was about 80 percent. There was no significant difference in the average attendance of directors among the various associations based on the number of directors. Meetings of the directors were held monthly in 17 associations and quarterly in 20 associations.

Directors were elected at the annual meetings by a membership vote of one-man one-vote method. The majority of the associations followed the practice of having open floor nominations. Five associations used a nominating committee to select nominees for directors. There was some indication that nominees for board members were selected by a few members by taking advantage of the use of the nominating committee.

In a majority of the associations the directors were very active in establishing policies of operation but left the general operation of the association in the hands of the manager. There were, however, some indications that the directors were not as active as they should be and all of the responsibility of both operating policy and general operations was left entirely up to the managers. One association had a completely dominating board and did not allow the manager to use his own initiative at all. Fourteen of the cooperatives did not pay their directors, whereas, the remaining associations followed the practice of paying a certain sum per meeting and mileage, or just paying them so much per mile to offset expenses incurred in going to and from the meetings. There was no relationship between attendance and compensation paid to directors.

The managers of the cooperatives had been employed by the associations for an average of about five years and several associations reported that they had never employed any other manager. Thirty-five percent of the associations reported that the reason for changing managers was because their previous manager went into business for himself. All indications were that the turnover in management personnel was fairly slow, since in only a few cases were the previous managers discharged. About 80 percent of the associations had no type of training program for other personnel of the association in case there might be a vacancy of the manager's position.

The average salary of the managers was approximately $3,800 per year, including bonus and commissions. The determination of the manager's salary seemed to be based upon education, experience and volume of business, with volume of business being the most important factor. Volume of business depended to a large extent on the area of location. Therefore, cooperatives having a large trade area had a larger volume of business and paid their managers more.

Over one-half of the managers employed by the associations had one year or more in college, and about 25 percent of the total had four years of college work. The managers also had an average of approximately ten years experience and a majority were well qualified to fill the manager's position. There was a lack of understanding of the cooperative principles by some of the managers, especially where there was a tendency to pick board members that were favorable to the manager. In nearly all cases the managers took care of all operating practices and did the hiring and discharging of other personnel. The managers, in addition to their regular job, aided the community as a whole by putting on field demonstrations, carrying out improvement programs, etc.

The associations accounted for their patron's equities by listing them as book credits, issuing stock, or by the card index method. Book credit was by far the most prevalent method employed in keeping the patron's equity accounts. Almost half of the associations had no provision for paying off the accrued equities of their patrons. The others followed the revolving-fund plan which ranged from one to eight years. The associations that were members of the Mississippi Federated Cooperatives (AAL) and were on a revolving-fund plan of less than seven years were taking a great deal of risk by paying off equities that they were to receive at a later date. It would seem much more desirable for these associations to adopt the same type of revolving-fund plan as that used by the Federation.

In order to determine the selling price of commodities most of the cooperatives followed the practice of adding about ten percent to the cost of the goods. Most of the associations wanted to sell at prevailing market prices, if these prevailing prices did not exceed the ten percent gross mark-up on the cost of goods.

Some marketing was done by all except five of the cooperatives. Cotton was handled on a 25 to 50 cents per bale basis, whereas, most of the other products were handled on a ten percent commission basis. The price prevailing in the local market was used by most cooperatives as the basis of establishing prices paid to farmers for products purchased from them. A combination of the local and central market prices was used by 12 of the associations.

Financial statements were usually made monthly and were used by the managers and directors. The cooperatives that were members of the Mississippi Federated Cooperatives (AAL) made operating statements more frequently than other associations. This was probably due to the close supervision of the auditing department of the federation. The same was true with the frequency of making audit reports. Most cooperatives followed the practice of making quarterly and semi-annual audit reports. These reports were used by the managers and directors and were read at the annual meeting to the members. It is doubtful if the members learned very much about the operation of the association by hearing the audit read. It seems that visual aid posters properly prepared would improve the use of these audit reports in bringing about a better informed membership.

Three associations had a very low current ratio. Their position was such that the current assets of the association were less than the current liabilities. One other significant characteristic was that the larger associations as a rule were the ones having a very low current ratio. Over 50 percent of the associations had a current ratio of less than 2 to 1, which is usually recommended as a minimum for sound business.

Several of the associations having a low current ratio, also had an unfavorable ratio of accounts receivable to current assets. The associations in the unfavorable positions were losing money on bad debts, and yet were having to borrow operating funds more extensively than associations which were not extending as much credit. The policy of liberal credit and the losses resulting from poor collections also reduced the net margins of such associations. These losses had to be supported by the patrons who paid for their goods in cash. The associations that had a high ratio of accounts receivable to current assets were handicapped by not having sufficient capital to purchase larger quantities for cash and get the benefit of volume discounts.

In comparing the net margins to the current liabilities, or the earning power of the associations, it was found that the six cooperatives having the lowest earnings were also extending the most credit to their patrons. These associations were earning only 22 cents for each one dollar in liabilities, whereas, the most favorable group of cooperatives were earning six dollars for each one dollar of current liabilities.

The earning power of the cooperatives, based upon total assets, seemed to indicate that those having the least invested in total assets were showing the greatest net earnings to their patrons. This would indicate that the associations having large investments were not utilizing their assets as efficiently, or that they had over-expanded, unless they were furnishing a needed service at a break-even cost. Since most associations were comparable in practices of operation, there would seem to be no good reason for the associations with larger investments to be less efficient unless they had poor utilization of facilities or over-expansion.

There appeared to be no significant relation between the size of business and the credit policy but that accounts receivable were more prevalent in the Delta area and in the areas where dairying was carried on extensively. In the dairying section credit was extended much more freely since many producers bought feed and supplies and paid for them at the end of each month.

The cooperatives having the largest

amount of capital in fixed assets were the newer cooperatives, and they had not depreciated their facilities as the older cooperatives had done. Since this was true, there seemed to be no indication that these associations had an unusual proportion of their capital invested in fixed assets.

There was no consistent relation between volume of business and operating expenses. However, it was found that the associations with the largest volumes of business were either the most or the least efficient, based upon the ratio of operating expenses to the total volume of business.

There were definite indications that some of the associations were using their personnel to a greater advantage than others. Indications were that the proportion of expenses for salaries and wages was affected some by the volume of business, but this did not seem to be consistent. Since the amount of salaries and wages was not related to any degree to volume of business, other reasons must explain why some associations were operating with less expenditure for salaries and wages than others. It is possible that some associations have hired personnel that were not needed, since the expenditure for salaries and wages was 4.3 cents per dollar of volume for the lower fourth compared to only 1.2 cents per dollar of volume for the upper fourth.

The relation between net margins and total volume of business indicated that the associations having over $300,000 in volume had either the highest or the lowest net margins. About an equal number of the large associations were in the upper fourth and the lower fourth.

These evaluations for the various ratios were not complete within themselves, since there were other influences that entered into the actual operation of the various cooperatives. Some of these influences were area of location, degree of cooperative interest in the community, custom of operation by the people in the area, the amount of service rendered to patrons, and community progressiveness. All of these factors could not be measured in quantitative terms, consequently, complete evaluation is limited. However, the business ratio analysis is probably one of the best methods available for testing the conditions for success of a cooperative, especially from the economic point of view.

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COMMERCIAL CHICK

Hatcheries As A Potential Market For Missssissippi Eggs

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TABLE OF CONTENTS

	Page
INTRODUCTION	3
The Problem	4
Scope and Method	4
DEVELOPMENT OF THE HATCHERY INDUSTRY IN MISSISSIPPI	4
Development of the Hatcheries Now In Operation	4
Hatcheries Now In Operation Compared To The Recent Hatchery Industry	5
Effect of Size on Development	6
Relation of the Production of Chicks to the Growth of Hatcheries	6
PRACTICES OF HATCHERIES THAT AFFECT THE ECONOMICS OF HATCHING-EGG PRODUCTION	7
Producer Requirements	8
Cost of Producer Requirements	9
Prices Received by Producers for Hatching Eggs Relative to the Prices Received by Producers for Market Eggs	13
Aid Given Hatching-Egg Producers by the Hatcheries in Disposing of Eggs Not Meeting Hatching-Egg Requirements	13
Aid Given Producers by Hatcheries in Disposing of Eggs during "Off-Hatching Season"	14
THE COSTS OF HATCHERY PRODUCTION AND THE INVESTMENT IN HATCHERY FACILITIES	15
Investment	15
Labor Cost	18
Supplies and Miscellaneous Expenses	19
Costs of Hatching a Chick	21
Relationship of Costs to Price of Chicks	22
EFFECTS OF EGG REQUIREMENTS OF HATCHERIES ON THE POTENTIALS OF HATCHERIES AS AN EGG MARKET	23
Egg Requirements of Hatcheries and Egg Production in Mississippi	23
Sources of Supply of Hatching Eggs	24
SUMMARY	25

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COMMERCIAL CHICK HATCHERIES AS A POTENTIAL MARKET FOR MISSISSIPPI EGGS

By W. E. CHRISTIAN, JR. and M. S. DICKERSON, JR.

Egg production in Mississippi is highly seasonal. Most of the total yearly production is in the late winter, spring, and early summer months. Prices received by farmers for eggs are inversely related to this seasonality of production. During the peak months, when most producers have a large supply to sell, the price of eggs is usually low and when the farmer has few to sell the price is high. Consequently, the total yearly returns to producers are often low. The remedy is a market that will take eggs at reasonable prices in months when production is high as well as in months of relatively low production —or increased production when the price of eggs is relatively high.

There is a possibility that commercial chick hatcheries will provide Mississippi egg producers an additional market for at least part of their eggs. With commercial broiler production increasing, there will likely be an increasing demand for chicks from commercial hatcheries. If the hatchery industry is of sufficient size or grows to sufficient size to demand a large number of eggs and if it is a stable, dependable industry, hatcheries may become an important market outlet for eggs in Mississippi.

Eggs used for hatching purposes must be produced under controlled conditions specified by the hatcherymen who use them. The effect of the requirements for hatching-egg production upon the economic desirability of hatcheries as an egg market depends upon two major factors: (1) the extra costs entailed in the production of hatching eggs, and (2) the extent to which the hatching-egg producer is compensated for carrying out these requirements through the prices received for hatching eggs.

However, due to peculiarities of the hatchery industry, the total amount of compensation received by hatching-egg producers would be reflected by factors other than the actual price of hatching eggs. These factors are: (1) the methods available for the disposition of eggs produced during "off-hatching seasons," and (2) the methods available for disposition of eggs not suitable for hatchery uses due to variations in size, shape, and weight. Once a hatcheryman establishes a hatching-egg-supply flock, he usually has sole right to the use of these eggs. Therefore, the producer would be permitted to sell eggs to other hatcheries only at the discretion of the hatcheryman who originally engaged him to supply eggs. During certain seasons of the year the hatcheryman who established the flocks may not want all of the producer's eggs. The producer normally would not have an outlet for his eggs established with other hatcheries, because the hatcheryman who established the flock probably would not know very far in advance exactly how many eggs he wanted. The producer may also find himself faced with a problem of disposing of eggs due to the physical variations in eggs produced. Eggs that vary as to size, shape, and weight more than is allowable by the hatcheries must be disposed of in some way other than as hatching eggs. Therefore, the actual price received for all eggs produced under hatching-egg conditions will be determined by the weighted average price of the "off-season" eggs, the eggs unsuitable for hatchery uses, and the eggs sold as hatching eggs.

The number of chicks commercial hatcheries can produce and the number of eggs they can set, will depend upon available facilities. Assuming any given demand, the volume at which these commercial chick hatcheries actually operate, or the number of eggs they set will be influenced to a large extent by the total costs incurred in hatching chicks and the allocation of these costs between "fixed" and "variable" costs.[1] Therefore, the investment in hatchery facilities and the nature of the total costs will have influence on the demand for hatching eggs.

The present sources of supply of hatching eggs and the seasonality of the total operations of the hatcheries will influence the number of eggs that can be sold to hatcheries by Mississippi egg producers. If hatcheries are obtaining a large number of eggs from out-of-state, this would indicate a potential market for Mississippi eggs, assuming the Mississippi producers had them available at the time they were needed and assuming the Mississippi eggs were of the quality desired.

The Problem

The object of this study is to appraise commercial chick hatcheries as a potential market for Mississippi eggs. The study includes an analysis of: (1) the growth and stability of the commercial hatchery industry in Mississippi, (2) the effects that the conditions under which hatching eggs must be produced have upon the economics of hatching-egg production in Mississippi, (3) the cost relationships of operating chick hatcheries and the effects of these relationships upon the stabilitv of the hatchery industry, and (4) the extent to which Mississippi producers are filling the egg needs of hatcheries.

Scope and Method

Both primary and secondary data are used in this study. The primary data were obtained by personal interview with hatchery operators during the summer of 1950. Owners of all commercial chick hatcheries in the state were interviewed to obtain detailed information on their individual operations. Prior to entering the field, it was anticipated that a 100 percent sample would be taken. Due to various reasons, however, complete data were obtained from only 61 of the 70 hatcheries located in the state. Partial data were obtained from an additional 4 operators while no data were obtained from five operators.

Development of the Hatchery Industry In Mississippi

Development of the Hatcheries Now In Operation

A study of the growth and development of the commercial hatchery industry in Mississippi will give an indication of its stability and at the same time point out its present size. In May 1950, there were 70 commercial chick hatcheries in Mississippi. Most of these hatcheries were relatively new enterprises, two-thirds of them having begun operation since January 1942. (See Table 1.) The oldest of these hatcheries began operation during the period 1917-21; 16 of the present hatcheries were operating before 1936 and 26 were in operation in 1941.

It seems that most of the hatcheries now in operation began as small units and "grew into the business." The average of the original capacities of all hatcheries studied was 23,400[2]. However, there has been a recent tendency toward larger capacities.

Prior to 1932 the average capacity of new hatcheries did not exceed 6,000 and in only one period prior to 1942 did the average original capacity of the hatcheries exceed 20,000. On the other hand, from 1942 through May 1950, there were only 2 years in which the average original capacity of the hatcheries studied was be-

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[1] "Variable" cost: that part of total cost which, within a period of a year or a hatching season, varies with the output of the hatchery. "Fixed" cost: that part of total cost which, within a period of a year or a hatching season, tends to remain approximately constant at all outputs above zero.

[2] Capacity: the number of eggs that incubators will hold including both incubating and hatching trays.

Table 1.[1] **The date of establishment of the 70 existing commercial hatcheries (May 1950) and their capacities, by periods, Mississippi, 1917-May 1950.**

Date	No. of hatcheries established	Average original capacity	Capacity changes of previously established hatcheries	Total capacity	Average total capacity
			Total		
		(thou.)	(thou.)	(thou.)	(thou.)
1917-21	3	6.0	—	18	**6.0**
1922-26	3	1.0	2	23	**3.9**
1927-31	6	5.8	25	83	**6.9**
1932-36	4	30.7	15	221	**13.8**
1937-41	10	10.8	487	816	**31.4**
1942	4	24.7	19	933	**31.1**
1943	7	18.6	212	1,276	**34.4**
1944	1	69.0	77	1,422	**37.4**
1945	4	12.3	48	1,519	**36.2**
1946	6	22.7	66	1,721	**35.9**
1947	0	-----	77	1,798	**37.5**
1948	5	20.0	94	1,992	**37.5**
1949	10	40.1	593	2,986	**47.4**
Jan.-May 1950	7	51.9	151	3,501	**50.0**
Totals	70	...	1,866		-----

[1] Source: Data for 5 of these hatcheries were obtained from the Extension Poultry Department, Mississippi State College. The information relative to 65 of the hatcheries was obtained from the survey of 65 commercial chick hatcheries, Mississippi, 1950.

low 20,000. The average original capacity of hatcheries established during 1949 and January-May 1950 was greater than that of any other period with the exception of 1944. Original capacities do not necessarily reflect the total capacities of hatcheries now in operation. Capacity changes of previously established hatcheries may cause the total capacity during any particular period to be either larger or smaller than the original capacity. During all periods from 1917 through May 1950, however, capacity changes of previously established hatcheries have been positive. From 1917-May 1950, capacity increases of previously established hatcheries have been larger than the capacity added by new hatcheries. The trend for established hatcheries to expand their capacities has been upward for all periods from 1917 through May 1950, with the exception of the period 1932-36

Hatcheries Now In Operation Compared To The Recent Hatchery Industry

A comparison of the number and capacity of the hatcheries that were in operation during the period, 1942 to 1949, with the number and capacity of the hatcheries that were still operating at the time of this study, will give some indication of the stability of the hatchery industry.

From 1942 to 1949 the hatcheries that were in operation in Mississippi increased from 38 to 71, or almost doubled. This increase, however, was apparently accompanied by an appreciable amount of turn-over in the composition of the firms making up the total during a particular period.

From Table 2 a comparison of the hatcheries in operation during a particular year with the number of these hatcheries still in operation (May 1950) indicates the rather high rate of turnover.

For instance, in 1944, 61 hatcheries were in operation. Of this number only 38 are still in operation (May 1950) indicating that 23 of the original 61 have gone out of business since 1944.

Table 2. Changes in capacity and number of total hatcheries in operation compared to portion of commercial chick hatcheies now in operation that were operating during selected periods, Mississippi, 1942-49.

Year	Total hatcheries[1]			Hatcheries now in operation which were operating during selected periods[2]			Capacity of hatcheries operating in indicated periods which later ceased operation	
	Number	Capacity		Number	Capacity			
	Total	Total	Average	Total	Total	Average	Total	Average
		(thou.)	(thou.)		(thou.)	(thou.)	(thou.)	(thou.)
1942	38	1,393	36.6	30	1,238	41.3	155	19.4
1943	42	1,726	41.1	37	1,435	38.8	291	58.2
1944	61	2,004	32.8	38	1,581	41.6	423	18.4
1945	65	2,260	34.8	42	1,678	40.0	582	25.5
1946	61	1,975	32.3	48	1,880	39.2	95	7.3
1947	54	2,206	40.8	48	1,959	40.8	247	41.2
1948	56	2,170	38.8	53	2,153	40.6	17	5.7
1949	71	3,023	42.4	63	2,987	47.4	36	4.5

[1] Source: Data supplied by the Extension Poultry Department, Mississippi State College.

[2] Source: Data for 5 of these hatcheries were obtained from the Extension Poultry Department, Mississippi State College. The information relative to 65 of the hatcheries was obtained from the survey of 65 commercial chick hatcheries, Mississippi, 1950.

Effect of Size on Development

Although there has been an appreciable amount of fluctuation as to the particular hatcheries that made up the total number operating at any particular time, most of the fluctuation in number seems to have been due to the smaller hatcheries. The average capacities of the hatcheries that were operating at some time during this period and later went out of business, exceeded 20,000 in only 3 of the 8 periods studied—1943, 1945, and 1947—the average capacities for those years being 58,200, 25,500, and 41,200, respectively. (See Table 2.) Only during 1943 and 1947 was the average capacity of the hatcheries that later went out of business larger than the average capacity of all hatcheries. In 1948 and 1949 the average capacities of the hatcheries that have since failed to operate were 5,700 and 4,500, respectively, while the average capacities of the hatcheries that have continued to operate were 40,600 and 47,400, respectively.

Relation of the Production of Chickens to the Growth of Hatcheries

From an examination of Table 3 it is apparent that there has been no pronounced upward trend in the total production of chickens in Mississippi (1942-1949) but there has been an upward trend in the production of commercial broilers corresponding rather closely to the upward trend in hatchery capacity. Probably one reason for the close relationship between the development of the hatcheries and commercial broiler production is that broilers are usually raised in sufficiently large lots to necessitate obtaining the chicks from commercial hatcheries. On the other hand, chickens other than commercial broilers may be raised in small enough lots to allow hatching on the farm.

The expansion of commercial broiler production probably explains the high percentage of heavy-breed chicks produced by hatcheries. Production of 64 hatcheries that reported breeds of chickens produced from June 1949-May 1950 was proportioned: 83 percent New Hampshires, 7 percent crosses, 3 percent White Rocks, 2 percent Barred Rocks, 2 percent Rhode Island Reds, 2 percent White Leghorns, and 1 percent miscellaneous breeds.

Table 3. Total hatcheries in operation and chickens raised, Mississippi, 1942-1949.

Year	Total hatcheries in operation[1]		Chickens raised[2]		
	Number	Capacity	Commercial broilers	Other chickens	All chickens
		(thou.)	(thou.)	(thou.)	(thou.)
1942	38	1,393	1,385	19,553	20,918
1943	42	1,726	2,078	19,553	21,631
1944	61	2,004	1,974	15,251	17,225
1945	65	2,260	2,369	16,737	19,106
1946	61	1,975	1,753	15,733	17,486
1947	54	2,206	3,400	14,474	17,874
1948	56	2,170	5,984	14,763	20,747
1949	71	3,023	8,378	15,944	24,332

[1] Data supplied by the Extension Poultry Department, Mississippi State College.

[2] United States Department of Agriculture, Agricultural Statistics, 1947, U. S. Government Printing Office, (Washingon, D. C.).

Practices Of Hatcheries That Affect The Economics Of Hatching-Egg Production

Owners of laying flocks in Mississippi were required to see that their flocks met certain requirements before eggs could be sold as hatching-eggs. To meet these requirements the owners had to incur costs which may not have been necessary if the eggs had been sold as market eggs.[3] Presumably, if the production of hatching-eggs did involve more costs than the production of market eggs, the hatching-egg producer was compensated by a higher price. However, due to the nature of the hatchery industry, factors other than the price received for eggs actually used by the hatchery influenced the amount of compensation for producing hatching-eggs. If the producer had a flock of sufficient size to supply the hatchery with all the eggs needed during certain seasons of the year, he may have found himself with more eggs than the hatchery wanted during other seasons. This is due primarily to seasonal variations in hatchery settings. On the other hand, the producer also probably found that part of the eggs produced under conditions specified were not accepted as hatching-eggs due to variations in size, shape and weight—that are beyond the control of the producer. Therefore, some of the factors which affected the actual compensation of hatching-egg producers are: (1) methods available to dispose of "off-season" hatching eggs, (2) methods available to dispose of eggs that failed to meet requirements due to size, weight, and shape variations, and (3) extra costs incurred in producing hatching eggs.

The following factors are analyzed in this section: (1) the production requirements that egg producers faced in order to sell eggs to hatcheries, (2) the aid that was given to producers by hatcheries in disposing of the producers' eggs during "off-hatching seasons," (3) the aid that was given the producer by the hatchery in disposing of those eggs that failed to meet hatchery requirements, and (4) the relative prices of hatching and market eggs. For this information only those data obtained from 47 of the hatcheries were suitable for analysis due to the following reasons: of the 65 hatcheries that participated in this study, 2 did custom hatching and hatched eggs from their own flocks while 16 used out-of-state eggs or eggs from their own flocks, or a combination of out-of-state eggs and eggs from their own flocks.

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[3] Market eggs: all eggs that were sold through market outlets other than commercial chick hatcheries.

Producer Requirements

Most of the requirements of hatching-egg flocks originated with the individual hatchery to which eggs were sold. However, the state law indirectly imposed a requirement concerning pullorum control upon all hatching-egg flocks in Mississippi. It requires that any incubator hatched chicks offered for sale had to be produced from flocks that had met the following requirements:

(1) The flock shall be tested for pullorum disease when the breeding birds are more than 5 months of age, and shall contain no reactors, the last test being made within 12 months immediately preceding the sale of hatching eggs or chicks or poults from any such flocks. (2) A flock having any reactors may not be retested for a period of 30 days (for chickens) or 21 days (for turkeys). (3) All reactors must be identified by tail cropping, have leg bands removed, and shall be immediately removed from the flock and from the premise, and sold for immediate slaughter only.[4]

The testing mentioned above must be done by a person licensed by the Livestock Sanitary Board. Although these state pullorum control requirements are imposed by the state at the hatchery level, they are in turn "shifted" to the hatching-egg flock owners.

All other requirements producers met in order to sell eggs to hatcheries were imposed by the hatcheries themselves. Twenty-seven of the forty-seven hatcheries using eggs from Mississippi flocks reported that they had vaccination requirements in addition to the testing requirements imposed by state law. (See Table 4.) Seventeen hatcheries required vaccination for both fowl pox and Newcastle. Ten hatcheries reported that they required vaccination only for fowl pox in addition to the state pullorum testing requirements. The maximum vaccination and testing requirements that hatching-egg flock owners had to meet were pullorum testing, and fowl pox and Newcastle vaccinations. These maximum requirements were required by 17 of the 47 hatcheries. Ten hatcheries required vaccination for fowl pox and testing for pullorum.

Hatching-egg flocks must, of course, have a sufficient number of roosters to ensure fertile hatching eggs. For the hatcheries studied, there was no uniform figure apparent as to the number of roosters required. The number was usually determined by the individual hatcheries to which eggs were sold.

The lowest rooster requirements were 6 per 100 hens. Only 3 of the 47 hatcheries using eggs from Mississippi had requirements this low. (See Table 4.) The largest number of roosters required by any of the hatcheries was 15 per 100 hens. This requirement was made by only 2 of the hatcheries studied. The average number of roosters required per 100 hens was approximately 8. Seventeen hatcheries required seven roosters per 100 hens. This was the largest number of hatcheries with a uniform rooster-hen ratio requirement.

Vaccination, testing, and roosters seem to have been the main additional requirements necessary to qualify for the hatching rather than the regular egg market. The other requirements made of egg producers by hatcheries did not vary much from the practices recommended for quality market egg producers. Thirty-nine of the forty-seven hatcheries that used eggs from Mississippi hatching-egg flocks required the producers to deliver the eggs once per week, while the other eight hatcheries required producers to deliver eggs every three to four days. (See Table 4.)

Most of the hatcheries did not have strict requirements as to the method producers used in holding the eggs prior to

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[4] Mississippi Extension Service, Extension Poultry Department, Poultry, Miscellaneous Publication, (date not available), section II-B.

Table 4. Requirements for producers of hatching eggs, commercial chick hatcheries, Mississippi, June 1949-May 1950.

Requirements	Number of Hatcheries
Vaccination and testing	
Pullorum test	20
Pullorum test & fowl pox vaccination	10
Pullorum test & fowl pox & Newcastle vaccination	17
Males per 100 hens	
6	3
7	17
8	13
9	2
10	8
12	2
15	2
Feed	
Breeder mash	9
Any balanced ration	5
Regularity of Delivery	
Once per week	39
Twice per week	8
Method of Holding	
Egg cellar	10
Any cool place	33
Any place where temperature was 50-60 degrees	4
Grade eggs	39
Humidity	0

[1]Source: Survey of 47 commercial chick hatcheries, Mississippi, 1950.

delivery to the hatchery. Thirty-three of the forty-seven hatcheries required only that the producer hold the eggs in a cool place. (See Table 4.) Ten of the hatcheries required that their egg producers hold the eggs in an egg cellar or egg pit while four hatcheries specified a temperature of fifty to sixty degrees for holding eggs. In most cases all of the storage requirements of the hatcheries could be met by the use of an egg cellar or egg pit. Thirty-nine of the forty-seven hatcheries required the producers to grade their eggs before delivering them to the hatchery.

Only 14 of the 47 hatcheries had any feed requirements for producers — 9 hatcheries required that laying flocks be fed breeder mash while 5 hatcheries required only a balanced ration. Market-egg producers did not feed breeder mash, of course, but the more progressive producers probably fed a balanced ration.

Cost of Producer Requirements

Requirements previously discussed obviously make it more expensive to produce eggs for hatcheries than for market.

The vaccination, testing, and rooster requirements gave rise to the greatest part of the additional costs necessary to sell eggs to hatcheries. To test for pullorum costs the producer about 3 cents per bird, to vaccinate for fowl pox about 1 cent per bird, and to vaccinate for Newcastle about 1 cent per bird.[5] Therefore, the total vaccination and testing costs to producers who supplied hatcheries with the highest vaccination and testing requirements (pullorum testing, fowl pox and Newcastle vaccinations) would be about 5 cents per bird. The total vaccination and testing costs to producers who supplied eggs to hatcheries with the intermediate (pullorum testing and fowl pox vaccination) and lowest (pullorum testing only) vaccination and testing requirements would be about 4 cents per bird and 3 cents per bird, respectively. Assuming that a hen will lay an average of 165 eggs per year,[6] or about 13.8 dozen, it will cost the hatching-egg producer .39 cents per dozen to meet the vaccination and testing requirements of the 17 hatcheries with the highest requirements, .31 cents for the 10 hatcheries with the intermediate requirements, and .23 cents for the 10 hatcheries with the lowest requirements, if 100 percent of the eggs were sold as hatching eggs. (See Table 5.) However, it is highly improbable that 100 percent of the eggs were sold as hatching eggs the year round, due to the variations in the physical qualities of the eggs and seasonal operations of the hatchery. This would raise the cost per dozen of those eggs used for hatching purposes. If it is assumed that 75 percent of the producers' eggs were used for hatching, it would cost the egg producer .52 cents per dozen hatching eggs to meet the vaccination and testing requirements of the 17 hatcheries with the highest vaccination and testing requirements, .41 cents for the 10 hatcheries requiring only pullorum testing and fowl pox vaccination or .31 cents for the 20 hatcheries requiring only pullorum testing. (See Table 5.) Still further, if it is assumed that only 50 percent of the producers' eggs were used for hatching purposes, it cost the producers .78 cents, .62 cents, or .46 cents per dozen hatching eggs to meet the vaccination and testing requirements of the hatcheries with the highest, intermediate, or lowest vaccination and testing requirements, respectively.

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[5] A statement made by James E. Hill, Department of Poultry Husbandry, Miss. State College.

[6] Approximate average for United States. United States Department of Agriculture, Crops and Markets, Vol. 27, U. S. Government Printing Office, (Washington 25, D. C.), p. 66.

All of the vaccination and testing costs incurred by producers who sold to hatcheries were an addition to the costs of producing market eggs where no vaccinating or testing is required. However, since mature birds are subject to pullorum, fowl pox and Newcastle, vaccinating and testing may be, in the long run, a saving also to the flock owners producing market eggs.

Roosters added more to the costs of producing hatching eggs than did vaccination and testing. These costs were primarily for feed for raising and maintaining the roosters along with the original cost of the cockerel. Also, there may have been other added cost involved in the form of a discount on the portion of the hatching eggs that were sold as market eggs due to their fertility—fertile eggs are of as good quality as infertile eggs when consumed soon after they are produced; however, when eggs spend considerable time in the marketing channels fertile eggs lose quality much faster than the infertile eggs.

Of the three main elements constituting the total costs of keeping roosters in the hatching-egg flock, the cost of feed for maintaining the mature roosters was most important. While the amount of feed that a rooster or hen will consume in a year varies by breeds, the average rate of consumption per year is about 95 pounds for roosters and about 85 pounds for hens.[7] To maintain the number of roosters required by the 3 hatcheries with the highest rooster-hen ratio, it cost the hatching-egg producer .067 pounds of feed for roosters for every pound of feed fed to hens, .168 pounds for the 2 hatcheries with the highest rooster-hen ratio, or .089 pounds to meet the average rooster requirements of all hatcheries studied.

By assuming the cost of feed to be 5 dollars per 100 pounds and the rate of production for hens to be 165 eggs per year, an estimate of the added cost of producing hatching eggs over the cost of producing market eggs due to the cost of maintaining the roosters can be made. (See Table 6.)

The original cost of the cockerels and the cost of raising them to maturity must be added to the cost of maintaining the mature roosters. While the original cost of cockerels varied by breeds, the average cost of a day-old cockerel was about 9 cents.[8] This means that it would cost the hatching-egg producer 54 cents to purchase the number of cockerels required by the hatcheries with the lowest rooster-hen ratio, and $1.35 for the cockerels required by the 3 hatcheries with the highest rooster-hen ratio. It takes an average of about 32 pounds of feed to raise the different breeds of cockerels from 1 day old to maturity.[9] Therefore, it will take 192 pounds of feed to raise the number of cockerels required by the

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[7] A statement made by James E. Hill, Department of Poultry Husbandry, Mississippi State College.

[8] op. cit.

[9] This assumes a mortality rate of zero in the cockerels.

Table 5. Costs per dozen hatching eggs due to testing and vaccinating laying flocks, according to the requirements of commercial chick hatcheries when different proportions of the eggs were used as hatching eggs, Mississippi, June 1949-May 1950.[1]

Testing and/or vaccinations required by hatcheries	Percent of eggs used as hatching eggs		
	100 (cents)	75 (cents)	50 (cents)
Pullorum test, fowl pox and Newcastle vaccinations	.39	.52	.78
Pullorum test and fowl pox vaccination	.31	.41	.62
Pullorum test	.23	.31	.46

[1] Calculated by dividing the cost of the testing and vaccination requirements per 100 hens and 8 roosters by the dozens of eggs produced by 100 hens per year. The resuling quotient was divided by the percent of the eggs that was used as hatching eggs.

Table 6. Cockerels—cost per dozen hatching eggs due to purchasing, raising to maturity and maintaining after maturity, the number of roosters required by commercial chick hatcheries when different proportions of the eggs were used as hatching eggs, Mississippi, June 1949-May 1950.

No. of roosters required by hatcheries per 100 hens	Percent of eggs used as hatching eggs											
	100				75				50			
	Purchasing[1]	Raising to maturity[2]	Maintenance after maturity[3]	Total	Purchasing[1]	Raising to maturity[2]	Maintenance after maturity[3]	Total	Purchasing[1]	Raising to maturity[2]	Maintenance after maturity[3]	Total
						(cents)						
6	.05	.82	2.43	3.30	.07	1.09	3.24	4.40	.10	1.64	4.86	6.60
7	.05	.96	2.84	3.85	.07	1.28	3.79	5.14	.10	1.92	5.68	7.70
8 (Av.)	.06	1.09	3.25	4.46	.08	1.45	4.33	5.86	.12	2.18	6.50	8.80
9	.07	1.23	3.66	4.96	.09	1.64	4.88	6.61	.14	2.46	7.32	9.92
10	.08	1.37	4.06	5.51	.11	1.83	5.41	7.35	.16	2.74	8.12	11.02
12	.09	1.80	4.88	6.77	.12	2.40	6.51	9.03	.18	3.60	9.76	13.54
15	.10	2.05	6.09	8.24	.13	2.73	8.12	10.98	.20	4.10	12.18	16.48

[1] Calculated by dividing the purchase price of the number of cockerels required per 100 hens by the dozens of eggs laid by 100 hens per year. This quotient was divided by the percent of eggs that was used as hatching eggs.

[2] Calculated by multiplying the pounds of feed required to raise the required number of roosters to maturity by the price per pound of feed. The resulting product was divided by the dozens of eggs produced by 100 hens per year. This quotient was divided by the percent of the eggs used as hatching eggs.

[3] Calculatd by multiplying the pounds of feed needed to maintain the required number of roosters by the price per pound of feed. The resulting product was divided by the dozens of eggs produced by 100 hens per year. The resulting quotient was divided by the percent of the eggs that was used as hatching eggs.

3 hatcheries with the lowest rooster-hen ratio, 480 pounds for the 2 hatcheries with the highest rooster-hen ratio, and 256 pounds for the average rooster- hen ratio of all hatcheries studied.[10]

The amount added to the cost of producing hatching eggs over market eggs due to the cost of cockerels and the feed to raise them can be estimated when different proportions of the producers' eggs are used as hatching eggs. (See Table 6.)

It will be observed that the additional cost of producing hatching eggs, due to the rooster requirements, increased as the percentage of eggs used for hatching purposes decreased. However, this would not necessarily be true if the hatchery operated only part of the year allowing the producer the possibility of disposing of the roosters. This would avoid the maintenance feed costs and at the same time permit the producer to sell infertile market eggs.

All of the hatchery requirements other than those pertaining to vaccination, testing, and roosters, seem to have been relatively insignificant from a cost standpoint. Methods specified for the producers to hold eggs prior to delivery to the hatchery apparently could be met with a very small cost and in most cases without an additional cash outlay. This is especially applicable to the 33 hatcheries who reported that they only required that producers hold the eggs in some cool place. The most rigid holding requirements could be met with the use of an egg cellar or pit.

The necessity of grading eggs, as required by 39 hatcheries, probably would have a slight effect on raising the cost of hatching-egg production. This added cost, however, would consist mostly of the producer's time consumed in the grading process. This would involve sorting by hand on the basis of size, shape, and weight.

The delivery requirements reported by the hatcheries were probably met with very little cost in the form of either the producers' time or cash. This is especially applicable for the 39 hatcheries which required the producers to deliver their eggs only once per week. Most farmers could probably make deliveries at least once per week without incurring any additional cost, combining the delivery with other activities.

Since the vaccination, testing, and rooster requirements gave rise to at least the major part of the increased costs, a summation of the costs incurred due to these requirements will give the primary costs of producing hatching eggs over the costs of producing market eggs. (See Tables 5 and 6.) Assuming that 100 percent of the producers' eggs were sold as hatching eggs, the primary cost of producing hatching eggs over the costs of producing market eggs was 8.63 cents per dozen eggs for hatcheries with the maximum vaccination, testing and rooster requirements, 4.77 cents for the hatcheries with average vaccination, testing and rooster requirements, and 3.53 cents for the hatcheries with pullorum testing and the minimum rooster requirements. If it is assumed that only 75 percent of the eggs were sold as hatching eggs and that the producer did not dispose of any of his roosters the primary costs of producing hatchings eggs over the cost of producing market eggs was 11.50 cents per dozen for hatcheries with maximum requirements, 6.27 for the hatcheries with average requirements, and 4.71 cents for the hatcheries with pullorum testing and the minimum rooster requirements. If it is assumed that only 50 percent of the producer's eggs were sold as hatching eggs and he did not sell his roosters, primary costs of producing hatching eggs over the cost of producing market eggs was 17.26 cents per dozen for hatcheries with the maximum requirements, 9.42

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[10] A statement made by James E. Hill, Department of Poultry Husbandry, Mississippi State College.

cents for hatcheries with average requirements, and 7.38 cents for the hatcheries with pullorum testing and minimum rooster requirements.[11]

Relative Prices of Hatching Eggs And Market Eggs

The average prices received by hatching-egg producers for their eggs relative to the average prices received by market-egg producers will give an indication of the extent to which hatching-egg producers were compensated for the extra costs that were incurred.

However, in studying the relative prices of hatching eggs and market eggs consideration must be given to the relative qualities of the hatching eggs and the market eggs for which these prices were paid. Most of the hatching-egg producers were probably much more specialized and produced better quality eggs than the average of the market-egg producers. Even if these hatching eggs were sold as market eggs they would probably bring a higher average price than most of the eggs that were produced for and sold as market eggs. To this extent the comparison between market eggs and hatching eggs is inadequate.

During all months studied from June 1949 to May 1950 prices received by producers for hatching eggs were considerably more than the prices received for market eggs. Hatching-egg producers enjoyed an average margin of 27.3 cents per dozen more for their eggs than the average price received by market-egg producers. (See Table 7.) Under the assumed conditions this gave the hatching-egg producer an average of 10.1 cents per dozen more for his eggs than the market-egg producer above the maximum primary hatching-egg production cost, even if it is assumed that only 50 percent of the producers' eggs were used at hatching eggs and he did not dispose of his roosters in the off season. In May, the difference in the price between hatching eggs and market eggs was largest. Even if it is assumed that the producers were able to sell only 50 percent of their eggs as hatching eggs, the hatching-egg producers were receiving about 18.8 cents per dozen more for their eggs above the maximum primary production costs than the market-egg producers. However, if it is assumed that the producer sold only 50 percent of his eggs as hatching eggs, the amount that the hatching-egg price exceeded the market-egg price during October, November, and December was less than the primary production costs by an average of about .7 of a cent. On the other hand, if it is assumed that 75 percent of the producers' eggs were sold as hatching eggs the hatching-egg price would have exceeded the market-egg price by more than the maximum primary cost of production during all months studied, or by an average of 17.88 cents per dozen for the 12 months from June 1949 to May 1950.

Aid Given Hatching-Egg Producers By The Hatcheries In Disposing Of Eggs Not Meeting Hatching-Egg Requirements

Thirty of the forty-seven hatcheries which obtained part or all of their supply of hatching eggs from Mississippi hatching-egg producers reported that they paid the producer hatching-egg prices for all of the eggs received and any eggs that did not meet hatching-egg specifications were sold as market eggs by the hatchery. (See Table 8.) However, all of the hatcheries in this group required the producer to grade the eggs before bringing them

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[11] These cost figures do not include the cost to the hatching-egg producer of breeder mash, which cost an average of about 15 cents per 100 pounds more than regular laying mash. Only 9 of the hatcheries studied required producers to follow this practice of feeding breeding mash. Where this practice is followed hatching flocks with minimum rooster requirements would have their cost increased .99 cents per dozen eggs if they sold 100 percent of the assumed production as hatching eggs. Flocks with average or maximum rooster requirements would have their cost increased by 1.01 and 1.08 cents per dozen, respectively.

Table 7. Average prices received by producers for hatching eggs and market eggs, Mississippi, June 1949-May 1950

Month	Average price received for hatching eggs[1]	Average price received for market eggs[2]	Difference in hatching and market egg price
	(cents per dozen)	(cents per dozen)	(cents per dozen)
June	69.3	38.1	31.2
July	74.6	40.4	34.2
August	74.7	46.0	28.7
September	73.0	53.4	19.6
October	73.6	56.6	17.0
November	74.4	57.8	16.6
December	71.9	56.0	15.9
January	68.4	39.5	28.9
February	66.8	31.8	35.0
March	61.7	29.8	31.9
April	63.0	29.5	33.5
May	64.3	28.5	36.0
Average	69.6	42.2	27.3

[1] Source: Survey of 47 commercial chick hatcheries, Mississippi, 1950.

[2] Source: United States Department of Agriculture, Bureau of Agricultural Economics, **Agricultural Prices,** June 1949-May 1950, U. S. Government Printing Office.

to the hatchery. The hatchery assumed no responsibility in helping the producer dispose of those eggs culled when graded by the producers. Therefore, in effect, none of the hatcheries paid hatching-egg prices for all eggs produced under conditions specified for hatching-egg production. Probably the hatcherymen would allow the producer a small error in grading and the producer benefited by the amount of the allowable error.

Nine hatcheries reported that they returned all eggs to the producer which did not meet specifications, while 5 hatcheries reported that the producers graded so carefully that practically all of the eggs received from the producers were used for hatching. Three hatcheries acted as a free marketing agency for the producer; that is, all eggs that did not meet hatching-egg specifications were sold by the hatchery for the producer and the producers were paid the price the hatchery received for them.

Table 8.[1] Aid given to hatching-egg producers by hatcheries in disposing of eggs not meeting hatching-egg requirements, Mississippi, June 1949-May 1950.

Method of disposition used by hatchery	Number of hatcheries
Sold as market eggs	30
Returned to producer	9
Sold as market eggs for producer	3
All eggs received used as hatching eggs	5
Total	47

[1] Source: Survey of 47 commercial chick hatcheries, Mississippi, 1950.

Aid Given Producers by Hatcheries in Disposing of Eggs During "Off-Hatching Season"

The percentage of capacity at which most of the hatcheries in Mississippi operate is quite seasonal, due largely to the seasonality of demand for baby chicks. The policy of the hatcheries in helping the producer dispose of hatching eggs produced during "off-hatching seasons" will influence the economics of hatching-egg production.

Fourteen of the hatcheries that used eggs from Mississippi flocks provided a relatively dependable market throughout the year. Twelve of these reported that they bought all the eggs from their hatching-egg flocks that met requirements the year round and paid hatching-egg prices. All 12 of these hatcheries "staggered" their hatching-egg flocks so that eggs would be available when needed. An additional 2 hatcheries reported that they maintained an outlet with other hatcheries so that if they did not need the eggs they could sell them to other hatcheries. Two of these hatcheries, however, did not take title to the eggs, but rendered their services free of charge to the producer in the marketing process. (See Table 9.)

Eighteen of the hatcheries helped their producers sell as market eggs the eggs not needed for hatching. Ten of these 18 bought the eggs from the producer (took title to them) at market-egg prices and resold them as market eggs. Eight hatcheries acted as market agencies for the hatching-egg producers in the sense that they helped their producers find market outlets. These 8 hatcheries, however, did not actually take title to the eggs. These hatcheries that helped hatching-egg producers dispose of eggs as market eggs usually had regular customers such as cafes, hotels, restaurants, or some other type customer who wanted high quality eggs for immediate consumption. Therefore, the eggs were not discounted in price due to their fertility. This service is especially important to the hatching-egg producer when the hatchery uses some of the producers' eggs as hatching eggs during most of the months, but the number it uses fluctuates up and down from month to month. Under these conditions the flock owner could not dispose of his roosters and produce infertile market eggs at any time during the year.

Table 9.[1] Aid given to hatching-egg producers by hatcheries in disposing of eggs during off-hatching seasons, Mississippi, June 1949-May 1950.

Policy of hatchery	Hatcheries
Buy as hatching eggs year round	12
Market as hatching eggs for producer	2
Buy as market eggs	10
Sold as market eggs for producer	8
Give producer no assistance	15
Total	47

[1] Source: Survey of 47 commercial chick hatcheries, Mississippi, 1950.

Fifteen hatcheries reported that they gave the producer no assistance at all in disposing of eggs during "off-hatching seasons." It is significant that most of these hatcheries operated for only 4 to 6 months during the year and then stopped completely. Therefore, the producer could dispose of his roosters during "off-hatching seasons" and sell quality market eggs for the remainder of the year.

The Costs of Hatchery Production And The Investment In Hatchery Facilities

An analysis of the composition and nature of the total costs incurred by hatcheries gives a further indication of stability of the hatchery industry as well as an indication of the potentialities for expansion. For the purpose of arriving at the total costs and the nature of these costs, the hatchery costs are analyzed under three groups:

(1) investment cost which consists of land, building and equipment;

(2) labor costs, excluding labor of owner-operators and his family;

(3) and supplies and miscellaneous expenses.

In this cost analysis the data as supplied by 59 hatcheries are used. Of the 65 hatcheries that participated in the study, two were custom hatcheries which were excluded in the cost analysis because their costs were not comparable with other hatcheries and the data from five additional hatcheries were unsuitable for cost analysis for various reasons.

For the purpose of analysis the hatcheries are grouped into seven groups according to their incubator capacity. These groups are: under 15,000; 15,000-29,999; 30,000-44,999; 45,000-59,999; 60,000-74,999; 75,000-89,999, and 90,000 and above.

Investment

The following method was used in determining investment in land, buildings, and equipment. The original investment, year investment was made, and the percent of the investment that was used by the hatchery business were obtained separately for land, buildings and different items of equipment. These data were obtained by use of a formal schedule taken through a personal interview with the hatchery operator. The original investments were then adjusted so that they were expressed in terms of 1949 equivalents[11]. The index of the costs of materials used in farm building, the index of farm real estate values and the index of farm machinery costs[12] respectively, were used to bring investments in buildings, land and equipment up to a 1949 equivalent. This was done by dividing the particular index for the year in which the investment items were purchased by the index in 1949 and then dividing the resulting index by the purchase price of the investment item and multiplying by 100.

The investment in buildings and equipment during the period June 1949-May 1950 was calculated by depreciating adjusted original investment on the basis of the age of the items involved. All equipment was depreciated at the rate of 10 percent per year using the straight-line method with 10 percent of the adjusted original value reserved for "junk value." Buildings were depreciated by the same method except the rate was four percent with 10 percent of adjusted original value reserved for "junk value." The adjusted original investment in land was considered the 1949 investment. In cases where the items involved were not used 100 percent in the hatchery business, the 1949 investment was multiplied by the percentage which the operator estimated it was used in the hatchery business, to obtain the 1949 investment in the hatchery business.

In some cases the hatcherymen had investment in land, building and equipment on which they were unable or did not give adequate information to determine their investment. In such cases the average investment of the group was used to represent their investment.

Only the 45,000-59,999 and the 60,000-74,999 size groups failed to have a larger total average investment than the hatcheries in any preceding size group. This resulted from the relative number of hatcheries in the 60,000-74,999 group that had rental land and buildings and the relatively low investment in all items of equipment as well as in land and buildings in the 45,000-59,999 size group.

The investment in incubators was of primary importance. If adequate incubators were available, it may have been possible to operate with a relatively small investment in other items of equipment. The importance of incubators relative to other equipment used by hatcheries probably explains the fact that the total average investment in incubators was several times as large as the total average investment in all other items of hatchery equipment. (See Table 10.)

The primary effect most of the other items of hatchery equipment had on the quantity of chicks produced was related to the "business" practices of the hatchery. For example, a hatchery that produced chicks primarily for broiler growers did not need as much space as a hatchery of equal capacity that produced chicks for customers who bought chicks at irregular intervals. This is due to the fact that "broiler" hatcheries usually had their chicks sold before the chicks were hatched and they were taken out of the incubators

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[11] 1949 equivalents are defined as the estimated cost of these items if they had been purchased under the 1949 general price level.

[12] These indexes were used because indexes relating directly to the cost of hatchery, buildings, land and equipment were not available. However, it is believed that these indexes fairly adequately reflect the changes in the cost of the particular items in the hatchery industry which they are used to represent.

Table 10*. Average investment of commercial chick hatcheries in land, buildings, and equipment, according to size groups, Mississippi, 1950, and average depreciation, June 1949-May 1950.

Incubator capacity	No. of hatcheries	Av. incubator capacity	Land	Building	Equipment					Av. total investment	Av. depreciation ******	Cost of investment
					Incubators	Brooders	Car & truck	Other equip. *****	Av. total equip.			
	No.	Eggs	$	$	$	$	$	$	$	$	$	$
0-14,999	15**	8,383	236	891	595	190	332	56	1,173	2,075	214	93
15,000-29,999	14**-****	21,139	1,174	1,281	1,373	238	276	60	1,947	3,876	326	174
30,000-49,999	13**	37,862	765	3,969	3,149	651	862	411	5,073	8,715	823	395
45,000-59,999	5	54,019	723	2,418	3,676	509	471	198	4,855	7,996	664	367
60,000-74,999	2***	62,500	150	4,500	4,473	------	935	85	5,494	7,818	852	348
75,000-90,000	3	80,333	1,484	3,262	11,150	443	792	450	12,836	17,582	1,531	803
90,000 & above	7**	142,571	813	6,868	13,311	196	2,587	667	16,716	21,030	1,993	952
Average, all hatcheries		43,221	758	2,572	3,822	337	759	240	5,112	7,699	712	349

*Source: Survey of 59 commercial chick hatcheries, Mississippi, 1950.

**Three hatcheries in each of these groups rented their land and buildings. The average investment in land and buildings was obtained by dividing the number of hatcheries that owned their land and buildings into the total investment in land and buildings, respectively.

***One hatchery rented its land and buildings (average investment was obtained same as in footnote 2).

****One hatchery rented its incubators (average investment was obtained by dividing the number of hatcheries that owned their incubators into the total investment in incubators.)

*****Includes egg and chick box holding racks, fans, heaters, tray cleaners, sprayers, auxiliary power facilities, and office equipment.

******Calculations: Depreciation for the year, June 1949-May 1950, 4 percent for buildings and 10 percent on all equipment.

and immediately delivered to the broiler producer. More broiler chicks were produced by hatcheries in the higher capacity groups. This explains the relatively small investment in brooders by the hatcheries in the upper capacity groups. On the other hand, the average investment in cars, trucks, and office equipment tended to increase as the capacity of the hatcheries increased.

The average investment in buildings was second only to the average investment in incubators. Most of the hatcheries with a capacity of less than 30 thousand were located in buildings also housing other types of businesses. Thus, only a part of the building was used for the hatchery business. For this reason the buildings of these smaller hatcheries were probably of better quality than that indicated by the investment in buildings. Hatcheries with capacities of 30 thousand and greater usually were located in buildings devoted primarily to the hatchery business.

The average investment in land did not seem to bear a very close relationship to the size of the hatcheries. It seems likely that the location of the hatchery affected the investment in land more than anything else. The most dis-proportionate variation in the investment in land occurred in the group with capacities of 60,000-74,999. Only one of the hatcheries in this group owned its land and this hatchery was located in a rural area. The investment in land probably would reflect the potential quantity of chicks that could be produced only in so far as the investment reflected the desirability of the location of the hatchery from the standpoint of demand for chicks.

Labor Costs

Labor costs were divided between skilled and common labor. This division was made because it was felt that costs which arose from the use of skilled labor[13] had a tendency to be relatively "fixed," especially during the hatching season, while labor costs that arose from the use of common labor[14] were probably "variable." An attempt was made to obtain the costs that were incurred by hatcheries for common and skilled labor for the period, June 1949-May 1950, by asking the hatcherymen the number of laborers, the rate of pay, the period for which the laborers were employed, the type of work done, and the percent of the laborer's time that was used in the hatchery. Those hatcheries for which information relative to labor costs could not be obtained were assigned the average labor costs of the other hatcheries within the same size group.

The hatcheries with less than 30 thousand incubator capacity had a relatively small cash outlay for labor costs. (See Table 11.) Cash labor costs for these small hatcheries were low because in most cases the hatcheries were operated entirely by the owner and his wife, with the aid of a little seasonal labor that was hired during peak hatching seasons to help with tray washing, cleaning up the hatchery, and setting eggs in the incubators[15].The hatcheries with less than a 15-thousand egg capacity used no skilled labor at all. Several of the hatcheries in this size group were operated primarily as "sideline" businesses on the part of the hatchery operators, in which cases the operators usually attended to the hatchery business in their spare time.

The hatcheries with incubator capacities of 30 thousand and more seem to

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[13] Skilled labor: productive efforts of those employees who were employed in positions that required a relatively high degree of training and who worked on at least a monthly salary.

[14] Common labor: the productive efforts of those employees who were employed in positions that required no preliminary training and usually worked by the hour or week.

[15] An estimate of the labor contribution of owner and family was obtained but due to several difficulties, only hired labor was used in figuring labor cost.

Table11.[1] Average yearly labor costs per hatchery by types of labor used according to size groups, commercial chick hatcheries, Mississippi, June 1949-May 1950[2].

Incubator capacity	Hatcheries	Type of labor Skilled	Common	Average total
		$	$	$
0-14,999	15	-------	91	91
15,000-29,999	14	184	108	292
30,000-49,999	13	634	590	1,224
45,000-59,999	5	1,476	312	1,788
60,000-74,999	2	2,460	520	2,980
75,000-89,999	3	1,325	-------	1,325
90,000 & above	7	4,835	1,908	6,743
Average all hatcheries		1,033	449	1,482

[1] Source: Survey of 59 commercial chick hatcheries, Mississippi, 1950.

[2] Does not include the time of the hatchery owner.

have required relatively larger cash expenditures for labor than the smaller hatcheries. After the hatcheries reached a capacity of 30 thousand, the owners usually needed some regular help in addition to temporary help during peak hatching seasons. The larger hatcheries usually required relatively more skilled labor than the smaller ones, primarily because the skilled labor requirements of the small hatcheries were met by the famliy of the operator. The hatcheries with capacities as much as 45 thousand were usually operated by a hired operator or hatcheryman instead of by the owner, who assumed a supervisory role and had some other business to which he devoted part of his time. Some of these larger "plants," especially those with capacities in excess of 60 thousand, also employed a night hatcheryman who could observe the incubators at night to see that they remained at the proper temperature. These regular hatcherymen were most common in the hatcheries with a capacity of 90 thousand and more. Generally, when regular operators were employed in hatcheries of less than 90 thousand capacity some other type of business was operated in connection with the hatchery, so that when the man was not busy in the hatchery he could utilize his time in the related business. Therefore, only a fraction of his salary was charged to the hatchery. The smaller the hatchery the more common was this situation. In addition to the hatcherymen, the larger hatcheries usually employed one or two egg trayers who were well trained in the technical phase of the hatchery operation. These employees were classed as skilled. Common laborers were used to help the regular egg trayers with the egg traying and the cleaning of the incubators and hatchery building, especially during peak hatching seasons. In some cases skilled workers also performed the functions of unskilled laborers. This seems to be especially applicable to the hatcheries in the 75,000-89,999 size group. Most of the hatcheries did not employ an appreciable amount of specialized office help.

Supplies and Miscellaneous Expenses

In attempting to arrive at the costs of supplies and miscellaneous expense items from June 1949-May 1950, problems of incomplete data were dealt with in much the same way as that of labor costs. That is, if a hatcheryman stated that he used certain supplies or incurred certain miscellaneous expenses, but did not know these actual costs, the average cost of each item to other hatcheries in the same size group was used.

Miscellaneous expenses are presented under the headings of Advertising, Power, Automobile Expenses, Parcel Post, and Express Expenses, and Other Expenses. This division is made because it

Table 12[1]. Average yearly cost per hatchery of supplies and miscellaneous expenses for commercial chick hatcheries, according to size groups, Mississippi, June 1949-May 1950.

Incubator capacity	Hatcheries	Supplies					Miscellaneous Expense					
		Disinfects & fumigants	Chick boxes & pads	Hatching eggs	Other supplies[2]	Av. total supplies[3]	Power	Auto expense	Parcel post & express	Advertising	Other expenses[4]	Av. total expenses
		$	$	$	$	$	$	$	$	$	$	$
0-14,999	15	10	79	1,775	7	1,871	86	69	13	60	119	350
15,000-29,999	14	9	134	2,644	17	2,804	64	110	13	59	181	427
30,000-44,999	13	30	361	6,707	49	7,147	184	476	171	145	665	1,640
45,000-59,999	5	27	545	14,458	8	15,038	315	144	258	140	125	981
60,000-74,999	2	139	979	30,319	6	31,443	638	0	8	1,800	472	2,868
75,000-89,999	3	113	891	21,114	21	22,139	350	633	0	20	130	1,133
90,000 & above	7	183	2,704	54,889	57	57,833	782	841	1,071	347	1,938	4,978
Average, all hatcheries		46	577	12,395	25	13,043	236	293	193	176	483	1,380

[1] Source: Survey of 59 commercial chick hatcheries, Mississippi, 1950.

[2] Includes wire, twine, staples, crinoline, excelsior, poultry spray, tags and survoil.

[3] Includes telephone, insurance, taxes, fuel for heating building, water, correspondence material and rent.

is felt that Advertising, Power, Automobile Expenses, Parcel Post and Express Expenses are "variable" where Other Expenses are "variable" but since they made up such a large proportion of the total expenses some of the costs of major supply items are presented separately in order to show their individual importance. (See Table 12.)

Hatching eggs and chick boxes and pads made up the largest part of the supply costs for all hatcheries. The average total cost of all supplies for all hatcheries was $13,043, the average total cost of hatching eggs for all hatcheries was $12,395, and the average total cost of chick boxes and pads for all hatcheries was $577. Thus hatching eggs and chick boxes and pads made up about 95 percent and 4 percent respectively, of the total average supply costs for all size groups. Of the remaining 1 percent, disinfectants and fumigants made up less than one-half, and "other supplies" made up the remainder.

The total average miscellaneous expenses showed an over-all tendency to increase as the size of the hatcheries increased, but there was a considerable amount of fluctuation in this over-all tendency. (See Table 12.) This fluctuation can probably be attributed to the fact that the cost of most of the items of expense to the hatcheries varied more with the "business practices" of the hatcheries than with their capacity. For example, if the hatcheries in any size group had a policy of delivering a large part of the chicks they sold, they probably had a relatively high automobile expense. Parcel post and express expenses were probably influenced largely by the quantity of chicks that were delivered by these methods. The variations in power expenses were caused largely by technological factors. Variations in power costs for any hatchery of a given capacity may be attributed to the types of incubators, the number of incubators making up the given capacity, the capacity at which the incubators were operated, and other technological factors beyond the scope of this study.

Costs of Hatching a Chick

The total costs incurred by hatcheries in producing a chick are divided into "fixed" and "variable" costs. "Fixed" costs included all skilled labor and office help that was used in the hatchery, that part of the miscellaneous expenses representing expenditures for telephone, insurance, taxes, water, correspondence materials, rent, and cost of investment. The investment cost was composed of one year's depreciation on buildings and all items of equipment, plus an allowance of 5 percent of the investment in land, buildings, and equipment as of May 1950. The "variable' costs were composed of all supplies used by the hatcheries, "unskilled" labor costs, and that part of Miscellaneous Expenses composed of power costs, gas for automobiles and/or trucks used in the hatchery, and parcel post and railway express charges.

"Fixed" costs made up a relatively small part of the total costs. The average "fixed" cost per chick ranged from a low of 10.5 percent of the total cost per chick for the hatcheries in the 60,000-74,999 size group, to a high of 23.3 percent of the total cost per chick for the hatcheries in the 30,000-44,999 size group. (See Table 13.) Hatcheries in the size groups that had the lowest "fixed" cost relative to total cost per chick also had the lowest absolute "fixed" cost per chick, 0.9 cent. The hatcheries in the group that had the highest fixed cost relative to total cost per chick also had the highest absolute fixed cost per chick. "Plants" in the 30,000-44,999 size group were the only hatcheries with a fixed cost per chick as high as 2.4 cents. The hatcheries in the 4 size groups over 44,999 all had an average fixed cost per chick of less than 1.5 cents and the hatcheries in the two size groups of less than 30,000 had average "fixed" costs per chick of less than 2.5 cents.

For all size groups, over 84 percent of the total costs incurred by hatcheries in producing a chick was variable costs. Variable costs per chick for the different size groups are shown in Table 13.

The relationship of high "variable" costs relative to "fixed" costs indicates that commercial hatchery production is flexible and sensitive to changes in chick prices. In an industry whose costs are largely variable the number of firms and their production levels are usually subject to rapid variations. It does not take a very sizable increase in price to attract new firms nor a very sizeable decrease in price to depress the marginal firms. With high variable costs relative to total costs it would probably take only a small decrease in the price of chicks for hatcheries to fail to recover more than their variable costs, assuming that hatcheries are not operating on a large margin. A hatchery is not likely to continue to produce unless the price of chicks will at least cover the variable costs incurred in producing the chicks. Conversely, a small increase in the price of chicks would probably be sufficient to attract new hatcheries into the industry since fixed costs make up such a small percentage of the total costs of production.

The average total cost of producing a chick increased as the size of the hatchery increased up through the 30,000-44,999 size group, where the average total cost was 10.3 cents, the highest for any size group. In the 45,000-59,999 group the average total cost per chick declined to 9.5 cents and in the 60,000-74,999 group it declined 8.6 cents. After this size group was passed, average total costs began to increase again.

The extent to which hatchery operators fully utilized their existing hatchery facilities influenced the average cost per chick as well as did the size of the hatchery. The influence of the size of the hatchery, however, seems to have been the most important. The intensity at which the hatchery facilities were used

Table 13[1]. Average yearly fixed, variable, and total costs per chick; percent average variable and average fixed costs are of average totals costs; and the number of times incubators were filled with eggs, according to size groups, commercial chick hatcheries, Mississippi, June 1949-May 1950.

Incubator capacity	Hatcheries	Average fixed cost per chick	Average variable cost per chick	Average total cost per chick[2]	Percent average fixed is of average total cost	Percent average variable is of average total cost	Average No. of times incubators were filled with eggs[3]
		(cents)	(cents)	(cents)			
0-14,999	15	1.3	6.9	8.2	15.9	84.1	4.3
15,000-29,999	14	2.2	7.8	10.0	22.0	78.0	2.3
30,000-44,999	13	2.4	7.9	10.3	23.3	76.7	3.4
45,000-59,999	5	1.3	8.2	9.5	13.7	86.3	4.8
60,000-74,999	2	0.9	7.7	8.6	10.5	89.5	8.8
75,000-89,999	3	1.3	8.0	9.3	14.0	86.0	4.2
90,000 & above	7	1.4	8.8	10.2	13.7	86.3	6.5
Average, all hatcheries		1.5	8.3	9.8	15.3	84.7	5.0

[1] Source: Survey of 59 commercial chick hatcheries, Mississipi, 1950.

[2] Does not include labor of the hatchery owner.

[3] Obtained by dividing the total incubator capacity into the total number of eggs set.

would affect, primarily, the fixed cost per chick; that is, as more chicks were hatched at a given fixed cost, the lower would be the fixed cost per chick until the hatchery reached its full capacity. The hatcheries in the 60,000-74,999 size group used their available facilities more intensely than did hatcheries in any other size group. (See Table 13.) Conversely, the hatcheries in the size group, 75,000-89,999, used their hatchery facilities to about the same intensity as those in the 0-14,999 size group but the average total cost per chick was nine-tenths of a cent lower for the hatcheries in the 0-14,999 size group. This is probably due to the fact that the very small hatcheries operated mostly in late winter and early spring when hatching egg cost was relatively lower than other seasons and they also had little hired skilled labor.

Relationship of Costs to Price of Chicks

The hatcheries in all size groups seemed to have received, on an average, a price that was sufficient to insure an "adequate margin" between the price per chick and the average total cost of producing a chick. (See Table 14.) The average margin between the price of chicks and the average total cost of production for the hatcheries in all size groups was about 3.2 cents per chick. The smallest margin between the price received per chick and the average total cost of producing a chick was an average of 2.6 cents for hatcheries in the size group of 90,000 and above. The highest margin between the price received per chick and the average total cost per chick was an average of 4.8 cents for hatcheries in the 0-14,999 size group. The margin between average total cost of production and the price received per chick was less than 3 cents per chick for the hatcheries in only three size groups. It must be realized that these margins also represent returns to labor for owner-operators and their families.

These relationships between the price of chicks and the cost of producing chicks indicate that the hatcheries in general are "economically sound." (See Table 14.) The indications are that the hatchery industry is likely to expand if the price of chicks remains at about the same level or eration. The price of chicks may decline substantially before the hatcheries fail to increases relative to cost of hatchery op-

Table 14.[1] **Average costs of producing a chick, prices received per chick, and number of chicks produced, according to size groups, commercial chick hatcheries, Mississipp, June 1949-May 1950.**

Incubator capacity	Hatcheries	Average fixed cost per chick	Average variable cost per chick	Average total cost per chick[2]	Average price per chick[3]	Margin between total average cost & average price received per chick	Average No. of chicks produced
		(cents)	(cents)	(cents)	(cents)	(cents)	(thou.)
0-14,999	15	1.3	6.93	8.2	13.0	4.8	30
15,000-29,999	14	2.2	7.83	10.0	12.9	2.9	39
30,000-44,999	13	2.4	7.9	10.3	13.1	2.8	104
45,000-59,999	5	1.3	8.2	9.5	14.2	4.7	104
60,000-74,999	2	0.9	8.2	8.6	12.6	4.0	445
75,000-89,999	3	1.3	8.0	9.3	13.6	4.3	283
90,000 & above	7	1.4	8.8	10.2	12.8	2.6	708
Average, all hatcheries		1.5	8.3	9.8	13.0	3.2	170

[1] Source: Survey of 59 commercial chick hatcheries, Mississippi, 1950.

[2] Does not include labor cost of the hatchery owner or his family.

[3] Weighted average price.

produce in the "long run" (they would fail to produce in the "long run" when the price received for chicks will not at least cover total costs). The price may decline even further (where price of chicks at least covers variable costs) before production is likely to be cut substantially in the "short run."

Effects Of Egg Requirements Of Hatcheries On The Potentials Of Hatcheries As An Egg Market

Egg Requirements of Hatcheries and Egg Production in Mississippi

The economic desirability of hatcheries as an egg market apparently will be influenced by the total demand for hatching eggs and the seasonal variation of this demand relative to the seasonal variation in egg production.

The total number of eggs used by commercial chick hatcheries from June 1949 to May 1950 made up about 4 percent of the total eggs produced in Mississippi during the same period. Since hatcheries used such a small proportion of the total eggs produced, it may appear that they would be relatively unimportant as a market outlet for eggs. The demand for eggs, as for most other agricultural products, is relatively inelastic[16]. If producers had been forced to sell hatching eggs as market eggs, it is quite probable that market-egg prices would have been depressed significantly. However, the influence of the demand for hatching eggs on the price of market eggs was made greater by the seasonal nature of this demand. The greater the concentration of hatching-egg requirements during the season of peak egg production, the more effective was this demand in alleviating the "seasonal price strain" on the egg market. At the same time, if hatcheries required most of their eggs during the peak seasons of egg production, they were probably able to obtain their eggs at lower costs than if they had bid the major portion of their egg supply away from market uses during the season when eggs were relatively scarce.

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[16] Thomsen, F. L., Agricultural Prices, McGraw-Hill Book Company, 1936, p. 409.

Both the setting of eggs by hatcheries and the production of eggs in Mississippi had a very distinct seasonal pattern during the period June 1949-May 1950. In general, the seasonal pattern of egg settings by hatcheries corresponded closely to the seasonal pattern of egg production. Of the total eggs used by hatcheries, the largest proportion was used during the season when egg production was greatest. The egg requirements of hatcheries were concentrated largely in the period January-May while egg production was concentrated largely in the period February-June[17]. (See Table 15) Within the period February-June, the egg supply was apparently most abundant from March through May when the seasonal index of egg production ranged from 146.9 in May to 159.4 in April. During the same period (March through May) the seasonal index of the eggs set by hatcheries ranged from 140.4 in May to 180.0 in March. Both egg requirements of hatcheries and egg production were relatively low except for the peak periods.

Sources of Supply of Hatching Eggs

The total quantity of eggs used by commercial chick hatcheries from June 1949 to May 1950 and the seasonal variation in this quantity, give an indication of the importance of hatcheries as an egg market for Mississippi egg producers. An analysis of the sources of the supply of hatching eggs will give a further insight into this problem. The proportion of the total supply of hatching eggs from each source of supply, the seasonal variation in the proportion of the total supply from each source, and the price paid for eggs from the different sources of supply must be included in an analysis of the potentials of hatcheries as an egg market. Hatcheries producing all or a part of their own hatching-egg supply probably would not produce market eggs as an alternative to hatching-egg production.

As hatcheries produce a larger proportion of their total egg supply, the smaller will be the possibility for a potential hatching-egg producer to find a market for his eggs. If hatching eggs from Mississippi flocks made up a relatively large proportion of the total eggs used by hatcheries during the peak egg production months, the possibility of hatcheries further easing the "seasonal strain" on the egg market would be weakened. If a large proportion of the total supply of eggs came from out-of-state, there would be possibilities for the expansion of hatching-egg production in Mississippi, providing hatching eggs produced in Mississippi were equally acceptable to the hatcheryman. Furthermore, if hatching eggs from out-of-state constituted a large proportion of the total quantity of hatching eggs used during the peak egg production season, the possibility of hatcheries in helping to alleviate the "seasonal strain" on the egg market would be enhanced.

A high price for hatching eggs relative to the price of market eggs would indicate favorable conditions for expansion of hatching-egg production by Mississippi egg producers. The higher these prices were relative to the prices of market eggs during the peak market-egg production season, the greater would be the potentialities of hatcheries in easing the "seasonal strain" on the egg market.

During the period June 1949-May 1950, out-of-state hatching eggs constituted a relatively large proportion of the total eggs used by hatcheries. Out-of-state eggs made up a larger proportion of total eggs used during the period when both egg production and hatchery production were relatively high. Hatching eggs from out-of-state hatching-egg flocks constituted 54.9 percent of the total eggs set by Mississippi chick hatcheries from June

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[17] The monthly trend effect in hatchery production has not been removed from these seasonal data because a sufficient amount of data was not available to do so. However, the monthly trend effect in egg production has been removed.

Table 15. Total eggs set by hatcheries and total eggs produced with seasonal indexes, Mississippi, June 1949-May 1950.

Month	Total eggs set by hatcheries[1]		Total eggs produced[2]	
	Number (thou. eggs)	Seasonal index[3]	Number (million eggs)	Seasonal index[4]
June	847	51.6	56	123.3
July	762	45.6	47	103.3
August	785	48.0	40	87.5
September	917	55.2	35	76.1
October	1,098	66.0	30	65.2
November	1,213	73.2	24	52.2
December	1,173	70.8	24	52.4
January	2,233	135.6	35	76.4
February	2,711	164.4	49	106.8
March	2,980	180.0	71	154.7
April	2,790	169.2	73	159.4
May	2,323	140.4	67	146.9
Total	19,832	1,200.0	551	1,204.2

[1] Source: Survey of 65 commercial chick hatcheries, Mississippi, 1950.

[2] Source: United States Department of Agriculture, Bureau of Agricultural Economics, Crop Production, monthly issues December 1949-November 1950.

[3] Calculated by multiplying by 12 the percentage of the total eggs that was set during each month.

[4] Deviation of monthly data from 13 month moving average.

1949 to May 1950. The use of out-of-state hatching eggs was concentrated to the highest degree in the period of January-May; however, about one-half of the total eggs used during June and July came from out-of-state. During the January-May period out-of-state eggs constituted an average of 60.9 percent of the total eggs set, while during the remainder of the year, August-December, out-of-state hatching eggs made up an average of about 41 percent of the total eggs used.

The hatchery owner's own eggs made up a relatively small proportion of the total eggs used by hatcheries. Of the total eggs set from June 1949 to May 1950, only 15 percent came from hatchery owners' flocks. (See Table 16.) There was a distinct seasonal variation in the quantity of hatchery owners' eggs used relative to the total eggs used.

Of the total eggs set by hatcherymen the proportion of eggs produced by their own hatching-egg flocks was greatest during August-December and least during February-June.

Hatching eggs from Mississippi flocks composed 30.1 percent of the total eggs that were used by hatcheries from June 1949 to May 1950, or slightly more than two times the quantity supplied by the hatchery owners' laying flocks. The total quantity of eggs set from non-hatchery owned Mississippi laying flocks did not show as distinct seasonal variation as did the total quantity of hatching eggs that came from hatchery-owned laying flocks.

Even though the relative quantities of eggs from the different sources of supply indicate favorable possibilities for the expansion of hatching-egg production, these data should be studied in the light of prices for hatching eggs relative to the source of supply[18]. For the year, June 1949 to May 1950, the average price of out-of-state eggs exceeded the average price of Mississippi eggs 6.8 cents per dozen. (See Table 17.) Higher prices were paid for out-of-state eggs during the

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[18] Hatchery owners reported that they credited the eggs produced in their own flocks at the same price paid for eggs produced in non-hatchery owned Mississippi flocks. The price of eggs produced in the hatchery-owner's flock will not be considered in this analysis since the hatchery-owner would logically use his own eggs rather than buy eggs.

Table 16.[1] Quantity of eggs set, according to source of supply and the percent eggs from each source of supply is of total eggs set, by months, commercial chick hatcheries, Mississippi, June 1949-May 1950.

Month	Source of supply				Percent eggs from each source of supply is of total eggs set			
	Own flock	Miss. flock	Out-of state flock	Total eggs set	Own flock	Miss. flock	Out-of state flock	Total
	(thou.)	(thou.)	(thou.)	(thou.)				
June	77	350	421	847	9.1	41.3	49.6	100
July	116	261	385	762	15.2	34.2	50.6	100
Aug.	215	196	373	785	27.4	25.0	47.6	100
Sept.	262	279	376	917	28.6	30.4	41.0	100
Oct.	249	421	429	1,098	22.7	38.3	39.0	100
Nov.	312	449	452	1,213	25.7	37.0	37.3	100
Dec.	261	405	508	1,173	22.2	34.5	43.3	100
Jan.	379	566	1,288	2,233	17.0	25.3	57.7	100
Feb.	309	771	1,632	2,711	11.4	28.4	60.2	100
Mar.	338	908	1,734	2,980	11.3	30.5	58.2	100
April	246	765	1,779	2,790	8.8	27.4	63.8	100
May	216	594	1,513	2,323	9.3	25.6	65.1	100
Total	2,980	5,965	10,890	19,832	15.0	30.1	54.9	100

[1] Source: Survey of 65 commercial chick hatcheries, Mississippi, 1950.

entire period studied, with the exception of the 4 months, July-October. The price paid for eggs produced out-of-state exceeded the price paid for eggs produced in Mississippi by a relatively larger amount during March-May, the period when the supply of market eggs was greatest. During this period the price paid for out-of-state eggs exceeded the price paid for Mississippi eggs by an average of 7.6 cents per dozen. This is of special significance because Mississippi prdoucers may be able to replace some of these out-of-state eggs with Mississippi eggs. If Missisippi producers can produce hatching eggs in sufficient quantity of the same quality as out-of-state producers, most of the hatchery owners probably would be willing to purchase eggs from Mississippi producers. Since the cost of keeping roosters constituted the major part of the cost of producing hatching eggs over the costs of producing market eggs (See Chapter III), some egg producers may find it advantageous to produce hatching eggs during the spring months and sell their roosters about July or August and produce market eggs during the remainder of the year.

In competing with out-of-state hatching-egg producers, Mississippi egg producers seem to have at least two factors in their favor: (1) relative hatchabilities of out--of-state and Mississippi eggs and (2) cost of transportation of out-of-state eggs. According to the reports obtained from the 65 hatcheries included in this study a 4.8 percent better hatch was obtained from Mississippi produced eggs than from out-of--state eggs. Mississippi eggs had an average hatchability of 78.6 percent while out-of-state eggs had an average hatchability of 73.8 percent[19].

Probably the reason that a better hatch was obtained from Mississippi eggs is that they were not transported as far and "shaken up" as much as the out-of-state eggs. Still further, it cost an average of 5.9 cents per dozen for transportation of the out-of-state eggs.

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[19] Includes all eggs set (both fertile and infertile).

Table 17.[1] **Weighted average prices paid for hatching eggs, according to source of supply, by months, commercial chick hatcheries, Mississippi, June 1949-May 1950.**

Month	Source of supply		(+) Out-of-state price exceeds Miss. price (—) Miss. price exceeds out-of-state price
	Miss. flock	Out-of-state flock	
	(cents/doz.)	(cents/doz.)	(cents/doz.)
June	69.3	72.0	+2.7
July	74.6	72.0	—2.6
August	74.7	70.6	—4.1
September	73.0	70.3	—2.7
October	73.6	71.7	—1.9
November	74.4	78.2	+4.2
December	71.9	74.1	+3.8
January	68.4	69.2	+ .8
February	66.8	68.2	+1.4
March	61.7	68.5	+6.8
April	63.0	69.9	+6.9
May	64.3	73.3	+9.0
Weighted yearly average	63.8	70.6	+6.8

[1] Source: Survey of 65 commercial chick hatcheries, Mississippi, 1950.

[2] Prices do not include cost of transportation.

Summary

In May 1950, there were 70 commercial hatcheries operating in Mississippi with a total incubator capacity of 3,501,000 eggs. Most of these hatcheries were relatively new. The three oldest hatcheries began operations during the period 1917-21, while about two-thirds of them began operations since January 1942.

Most of the hatcheries started operations as relatively small units and "grew into the business." During all periods from 1917-May 1950, the capacity changes of previously established hatcheries have been upward.

In reaching its present size, the Mississippi hatchery industry has apparently had an appreciable amount of turn-over in the firms making up the total at any particular time. During all periods studied from 1942-1949, there were apparently many hatcheries in operation that later went out of business. Most of the fluctuations in hatchery numbers, however, have been due to the in-and-out movement of small hatcheries.

While there has been no pronounced upward trend in the total production of chickens in Mississippi (1942-49), there has been an upward trend in the production of commercial broilers that corresponded rather closely to the upward trend in hatchery capacity.

Egg producers were required to see that their laying flocks met certain requirements before the eggs from these flocks were acceptable at the hatchery for hatching purposes. The primary requirements that added to the costs of producing hatching eggs over the costs of producing market eggs were for testing for pullorum, vaccination for fowl pox and for Newcastle diseases, and the cost of roosters. With the exception of testing for pullorum, requirements that any particular egg producer faced depended upon the hatchery which he was supplying eggs. A Mississippi law specifies that all eggs hatched in the State must come from pullorum-free flocks, if the chicks are offered for sale. In addition to testing for pullorum, 10 hatcheries required vaccination for fowl pox and 17 for fowl pox and Newcastle. Rooster requirements ranged from 6 to 15 roosters per 100 hens, while the average for all hatcheries was 8 roosters per 100 hens. The hatcheries also had requirements relative to the method of holding eggs prior to delivery to the hatchery, regularity of delivery, and grading of eggs. These requirements could usually be met with very little addition to the cost of producing good grade market eggs.

In arriving at the cost of producing hatching eggs over the cost of producing market eggs, the following assumptions were made: (1) the cost of testing for pullorum at three cents per bird; for fowl pox one cent per bird, and Newcastle one cent per bird; (2) an average of 32 pounds of feed is required to raise one cockerel from one day old to maturity (no attempt was made to obtain cost re- sumes about 85 pounds of feed per year; sulting from mortality of cockerels); (3) one rooster consumes an average of 95 pounds of feed per year; (4) one hen con- (5) one hen produces 165 eggs per year, and (6) a feed cost of 5 dollars per 100 pounds. No attempt was made to determine the housing cost of roosters since it was felt that in most cases this would be minor.

Eggs produced under the conditions specified for hatching egg production will vary as to the proportion used as hatching eggs due to two reasons: (1) seasonal variation in egg requirements of hatcheries, and (2) variation in physical qualities of eggs. If 100 percent of the producer's eggs were sold as hatching eggs (which is very unlikely), the primary cost per dozen of hatching eggs over the cost of producing market eggs was 8.63 cents, when maximum requirements were met; 4.77 cents, when average requirements were met and 3.53 cents, when minimum requirements were met. If it is assumed that only 50 percent of the producer's eggs were sold as hatching eggs, the cost of producing hatching eggs over cost of producing market eggs was 17.26 cents, 9.54 cents and 7.06 cents per dozen, respectively.

During the year the study was made. Hatching egg producers received an average premium of 27.3 cents per dozen for their eggs over the average price received for market eggs.[20] In addition to the price differential, some of the producers received aid from the hatcheries in disposition, through market-egg channels, of eggs surplus to hatchery needs and eggs that did not meet hatching egg specifications. Fourteen hatcheries provided a relatively dependable year-round hatching egg market.

The average total investment in hatcheries was $7,699 and ranged from $2,075 for hatcheries with an incubator capacity of less than 15,000 eggs to $21,030 for hatcheries with a capacity of 90,000 and above. For hatcheries of all sizes, the investment in equipment constituted approximately 66 percent of the average total investment per hatchery while investment in land and buildings constituted the remaining 34 percent. The investment in incubators alone accounted for about 50 percent of the average total investment.

Supplies and miscellaneous expenses were the major components of hatchery cost. Average expenditure for supplies for all hatcheries was $13,043, of which the major part was for hatching eggs and chick boxes and pads, while average miscellaneous expenses were $1,380. Average labor expenditure was $1,482 of which $1,033 was for skilled labor and $449 was for common labor.

The nature of hatchery costs would contribute to a high degree of flexibility and sensitivity to price changes when hatcheries operate near the cost of production level. "Variable" costs made up an average of 84.7 percent of the total cost of hatching a chick. The hatcheries with capacities of 60,000-74,999 had the highest percentage of "variable" cost relative to "fixed" cost, while the hatcheries in the 30,000-44,999 group had the lowest percentage.

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[20] In areas where the producer of market eggs could get a premium above average market price in Mississippi the 27.3 cents premium would be reduced accordingly or vice versa.

The average margin between the price received per chick and the cost of hatching a chick for all hatcheries was 3.2 cents. This margin ranged from a high of 4.8 cents for the 0-14,999 size group to a low of 2.6 cents for the 90,000 and above group.

Hatcheries set a total of 19,832,000 eggs during the year of the study. About two-thirds of these eggs were set during the period January-May, a period when egg production as a whole was at a peak.

Hatcherymen obtained 54.9 percent of their hatching eggs from out-of-state; 30.1 percent from Mississippi flocks other than their own flocks, and 15.0 percent from their own flocks. Both the quantity of eggs that came from out-of-state and the quantity that came from the hatcherymen's flocks, relative to total eggs used, showed greater seasonal variation than did the quantity used from Mississippi flocks.

During the period, June 1949-May 1950, the price paid for eggs from out-of-state exceeded the price paid for eggs produced in Missisippi by an average of 6.8 cents per dozen. These price relationships when related to the large quantity of eggs that came from out-of-state are of special significance because Mississippi producers may be able to replace some of these out-of-state eggs with Mississippi eggs. In competing with out-of-state producers, Mississippi producers are in a relatively favorable position for several reasons: (1) the cost of producing hatching eggs and prices received are generally favorable; (2) hatchability of Mississippi eggs is better than out-of-state eggs; and (3) the cost of transportation of out-of-state eggs is relatively high.

LIST OF TABLES

Table Page

1. Date of establishment of the 70 existing commercial hatcheries (May 1950) and their capacities 5
2. Changes in capacity and number of total hatcheries in operation 6
3. Total hatcheries in operation and chickens raised, Mississippi, 1942-49 7
4. Requirements for producers of hatching eggs, commercial chick hatcheries, Mississippi, June 1949-May 1950 9
5. Cost per dozen hatching eggs due to testing and vaccinating laying flocks 11
6. Costs per dozen hatching eggs due to purchasing, raising and maintaining roosters required by commercial chick hatcheries 11
7. Average prices received by producers for hatching eggs and market eggs, Mississippi, June 1949-May 1950 14
8. Aid given producers by hatcheries in disposing of eggs not meeting hatching-egg requirements 14
9. Aid given producers in disposing of eggs during off-hatching seasons 15
10. Average investment of commercial chick hatcheries in land, buildings, and equipment, and average depreciation 17
11. Average yearly labor costs per hatchery by types of labor used 19
12. Average yearly cost per hatchery of supplies and miscellaneous expenses 20
13. Average yearly fixed, variable, and total costs per chicks; percent average variable and average fixed costs are of average total costs; and the number of times incubators were filled with eggs 22
14. Average cost of producing a chick, prices received per chick, and number of chicks produced 23
15. Total eggs set by hatcheries and total eggs produced with seasonal indexes 25
16. Quantity of eggs set 26
17. Weighted average prices paid for hatching eggs 27

BULLETIN 493 AUGUST, 1952

Electricity on Farms

In the Clay Hills Area of Mississippi

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

In cooperation with the Bureau of Agricultural Economics
United States Department of Agriculture.

TABLE OF CONTENTS

Page

LIST OF TABLES 4

LIST OF FIGURES 5

PREFACE 6

INTRODUCTION 7

- Mississippi Has Lagged in Farm Electrification 7

RESEARCH TECHNIQUE 9

- Objectives of Study 9
- The Study Area 9
- Sample Selection 10
  - Enumeration 10
  - Presentation of data 10
  - Rural residence handled separately 10

USE OF ELECTRICITY ON FARMS 10

- Upward Trend in Consumption 11
  - Electric equipment added gradually 13
  - Wide variations among farms 14
  - No seasonal trend 14
- More Electricity Used Where Rates Are Low 15
  - Subdivisions of study area 15
  - Consumption highest in northern counties 15
  - Characteristics of electrified farms 16
  - Equipment inventories differ 17
- Large Farms Use More Electricity 18
  - Large farms have more equipment 20
  - Individual farm differences 20
- Effect of System of Farming 20
  - Basis for classification 20
  - Dairy farms used most electricity 22
- Consumption Influenced by Tenure of Operator 23
  - Owner-operators have most equipment 23
- Income and Use of Electricity Related 24
  - Income defined 24
  - High income farms use more electricity 24
  - Wide variations among farms 27
- Lighting Farm Buildings 27
- Electricity Pumps Water 29
- Alternative Sources of Energy 30
  - Household operations 30
  - Farm operations 31
  - Cost of electricity 31
  - Comments of farmers 32

USE OF ELECTRICITY BY RURAL RESIDENCES 33

- Characteristics of Rural Residences 33
- Electrical Equipment 33

OUTLOOK FOR FUTURE USE 34

SUMMARY 36

LIST OF TABLES

Table		Page
1.	Changes in population and in agriculture, Clay Hills Area of Mississippi, 1930-1950	9
2.	Average consumption of electricity per farm by year of electrification, 1940-1949	11
3.	Electricity used per farm, 1949, and pieces of electrical equipment in use per 100 electrified farms by period of electrification, sub-area, tenure of operator and income group, Aug., 1950	12
4.	Household equipment per farm and percentage of farms having specified kinds, by date of electrification, July, 1950	13
5.	Distribution of farms by electricity used in 1949, by date of electrification	14
6.	Average consumption of electric energy in farms, by period of electrification, by months, 1940, 1945, and 1949	14
7.	Consumption of electric energy per farm by sub-areas, 1940-49	15
8.	Characteristics of electrified farms, by sub-areas, 1949	16
9.	Characteristics of electrified farms, by size of farm, 1949	18
10.	Electricity used per farm, 1949, and pieces of electrical equipment in use per 100 electrified farms by system of farming and size of farm, August, 1950	19
11.	Household equipment per farm and percentage of farms having specified kinds, by size of farm, July, 1950	21
12.	Distribution of farms by electricity used and by acres operated in 1949	21
13.	Characteristics of electrified farms, by system of farming, 1949	22
14.	Household equipment per farm and percentage of farms having specified kinds, by system of farming, July, 1950	23
15.	Characteristics of electrified farms, by tenure of operator, 1949	24
16.	Characteristics of electrified farms, by income groups, 1949	25
17.	Household equipment per farm and percentage of farms having specified types, by 1949 total income, July, 1950	26
18.	Farms with various types of buildings and percent of buildings wired, by 1949 income groups and types of buildings, 1949	28
19.	Farms with running water and bathrooms, July, 1950	29
20.	Miscellaneous water supply on electrified farms, by sub-areas, July, 1950	29
21.	Farms with electric and gas kitchen ranges and water heaters, electrified farms, July, 1950	30
22.	Farms with specialized dairy equipment, by numbers of cows milked, July, 1950	31
23.	Farms with electric and non-electric chick brooders, by number of chicks raised, 1950	31
24.	Average consumption and cost of electricity per farm and per kilowatt-hour, 1940-49	32
25.	Characteristics of electrified rural residences, 1949	33
26.	Selected household equipment in 62 rural residences, July, 1950	33
27.	Estimated average annual consumption of electricity per farm by major uses, 1949 and 1960	35
28.	Consumption and cost of electric energy, Clay Hills Area, 1949 and estimates for 1960	35

APPENDIX TABLES

Table Page

1. Electric equipment on farms, by date of electrification, July, 1950 38
2. Electrical equipment on farms by size of farm, July, 1950 39
3. Electrical equipment on farms, by system of farming, July, 1950 40
4. Electrical equipment on farms, by 1949 total income groups, July, 1950 41
5. Consumption of electric energy per farm, by 1949 income groups, 1940-49 42

LIST OF FIGURES

Figure Page

Figure 1. Counties comprising the Clay Hills type-of-farming area ... 8

Figure 2. Consumption of electric energy per farm, by 1949 income groups, 1940-49 26

PREFACE

This study, made in the Clay Hills area of Mississippi, is concerned with some economic aspects of farm electrification. It is primarily descriptive, presenting experiences of farmers in the use of electric energy from central-station sources. It is one of a series of related studies made in various type-of-farming areas of the country. These studies were made possible by the cooperative efforts of state agricultural experiment stations and the Bureau of Agricultural Economics. Similar studies were made in the states of Georgia, Tennessee, Kansas, North Dakota, Wisconsin, Iowa, and Washington. They were made under authority of the Agricultural Marketing Act of 1946 (RMA, Title II).

Many persons made valuable contributions to this study. Among these were: R. J. Saville, Head, Department of Agricultural Economics, Mississippi Agricultural Experiment Station; F. M. Hunter, Rural Electrification Specialist, Mississippi Agricultural Extension Service; M. R. Cooper, Bureau of Agricultural Economics; and J. P. Schaenzer of Rural Electrification Administration. The field enumerators were A. D. Seale, Jr., Sidney Ishee, Claude T. Lowry, Jr., Albert R. Legett, and Rupert B. Johnston, all students at Mississippi State College. Mrs. Barbara Reid of the Mississippi Agricultural Experiment Station was responsible for most of the computations.

The power suppliers serving the study area freely provided data on the consumption and cost of electricity for the farms in the survey. And finally, the ready cooperation of the farmers interviewed is gratefully acknowledged.

ELECTRICITY ON FARMS IN THE CLAY HILLS AREA OF MISSISSIPPI

By

J. P. GAINES[1] and JOE F. DAVIS[2]

INTRODUCTION

Not many years ago, there was a distinct difference between rural and urban areas in the prevailing levels of living. Some of this disparity was due to differences in income, which still prevail to some degree, but most of it was caused by differences in availability of services. In recent years, the gap between the services and facilities conveniently available to urban and rural people has narrowed considerably, mainly because of the extension of central-station electric service to rural areas. Electric service has made possible far-reaching changes in rural living, including the use of modern household equipment to reduce the drudgery connected with household work; lighting that is much superior to that given by kerosene lamps; water that can be obtained by turning a faucet rather than tugging at a rope or working a pump handle; and farm equipment of various kinds that reduces the labor needed in farm production activities. It has stimulated diversification of farm enterprises in areas long in need of adjustment from a one-crop type of agriculture. Other benefits, also, have come from the electrification of farms. These have tended to raise the level of rural living or to reduce the cost of producing farm products.

Mississippi Has Lagged in Farm Electrification

Mississippi has lagged behind most states in percentage of farms electrified. On January 1, 1935, when 11 percent of the farms in the United States were electrified, only 1 percent of Mississippi farms had central-station service. By 1945, the percentage of Mississippi farms with electric service had increased to 19, while the national percentage had risen to 46. On June 30, 1951, approximately 62 percent of Mississippi's farms were connected to a distribution system. This represented a threefold increase from 1945, but it was still much below the national average of 84 percent.

Most data concerning the proportion of farms with electric service are somewhat misleading as units operated by croppers are classified as farms by the Census of Agriculture. Mississippi has a relatively large proportion of farms operated under the cropper system. It is not unusual for the operator's house on a farm to be wired for electricity, while some, or all, of the cropper houses are not wired. In the study reported here, all of the operator dwellings on the sample farms were wired for electicity but only 55 percent of the houses of croppers and laborers were wired. Reasons given for not wiring these houses were: (1) croppers did not wish to be responsible for the electric bill, (2) the houses were in such poor condition that they were not worth wiring, (3) the houses were unoccupied much of the time, and (4) operators were doing away with cropper labor by substituting machines for hand labor, especially where they were shifting to enterprises requiring less hand labor. It is apparent, therefore, that the proportion of electrified farms reported for Mississippi would be much higher if units operated by croppers were not classified as farms.

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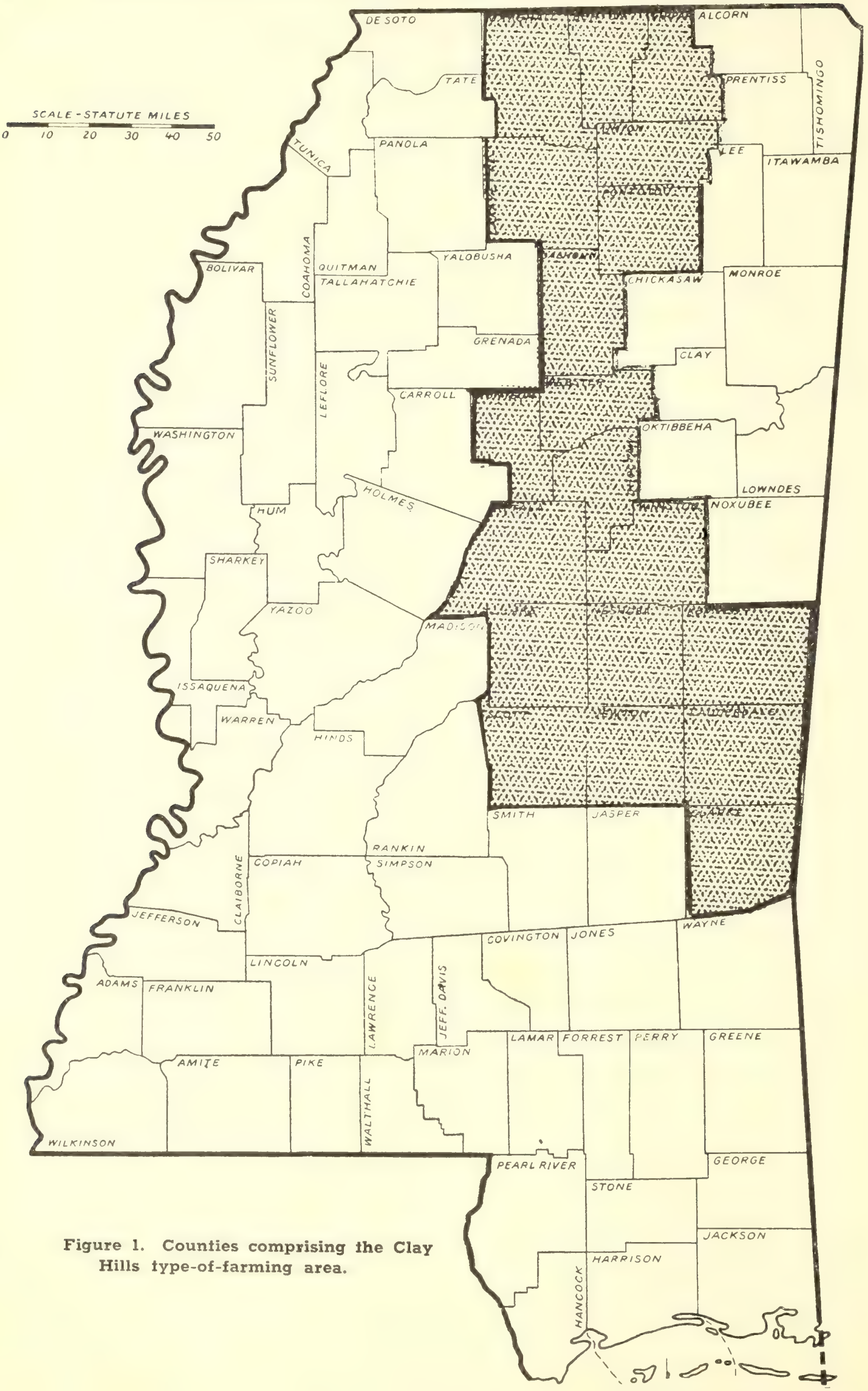
[2] Agricultural Economist, Bureau of Agricultural Economics, United States Department of Agriculture.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TALLAHATCHIE
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WEBSTER
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HUM
WINSTON
NOXUBEE
SHARKEY
YAZOO
MADISON
NESHOBA
ISSAQUENA
WARREN
HINDS
SCOTT
NEWTON
LAUDERDALE
SMITH
JASPER
CLARKE
RANKIN
COPIAH
SIMPSON
CLAIBORNE
JEFFERSON
WAYNE
COVINGTON
JONES
LINCOLN
ADAMS
FRANKLIN
LAWRENCE
JEFF. DAVIS
LAMAR
FORREST
PERRY
GREENE
MARION
AMITE
PIKE
WALTHALL
WILKINSON
PEARL RIVER
GEORGE
STONE
JACKSON
HARRISON
HANCOCK

Figure 1. Counties comprising the Clay Hills type-of-farming area.

RESEARCH TECHNIQUE

Objectives of Study

This is one of a series of related studies made or proposed for the major type-of-farming areas of the country. These studies deal with certain economic aspects of farm electrification—primarily factors affecting consumption of electric energy on farms and with the place of electricity and electrical equipment in the whole scheme of farm mechanization. This study, made in the Clay Hills Area of Mississippi, is more specifically concerned with : (1) trends in the use of electric energy in the area, (2) relationship between the use of electricity (and electrical equipment) and the economic and physical characteristics of the farms, (3) costs incurred in the use of electricity, including the costs of energy, wiring, and equipment, and (4) probable changes in the use of electricity in the foreseeable future.

The Study Area

The nineteen counties that comprise most of the Clay Hills Type-of-Farming Area are indicated in Figure 1. This has long been an area of small farms, most of which depend primarily upon cotton as the source of farm income. In recent years it has adjusted rather rapidly to a more diversified agriculture, and off-farm employment has become more widespread. For example, from 1930 to 1950, acreage in cotton declined more than 50 percent (Table 1). Cattle and calves increased 73 percent, whole milk sold, 147 percent, and hogs and pigs on farms, 97 percent.

This is an area of high density of rural population, with only 15 acres of farm land per person on farms in 1930, and only 22 acres per person in 1950. The rural population is declining relative to the urban population. In 1950 it comprised about 60 percent of the total population. Urban centers and local markets are small. Only one city (Meridian) has more than 10,000 population.

Manufacturing is increasing in volume; but, as compared to agriculture, it is still relatively minor in terms of persons employed. From 1939 to 1947, the number of manufacturing establishments increased 55 percent, and the number of persons employed in manufacturing 54 percent. However, in 1947, only 14,000 of a total population of more than 400,000 were engaged in manufacturing. The manufacturing that has developed has stimulated the expansion and development of service and trade occupations that have further served to balance the economy of the area. Following are the changes in manufacturing in the area from 1939 to 1947, as reported by the 1948 Census of Manufacturers:

	1939	1947	Increase
	Number	Number	Percent
Establishments	291	451	55
Employees	9,238	14,227	54

Table 1. Changes in population and in agriculture, Clay Hills Area of Mississippi, 1930-1950.

Item	Year		Percent change
	1930	1950	1930-1950
Population:			
Total persons	408,076	409,941	+ 0.5
Farm population	296,852	246,000*	— 17.2
Percent farm	77	60	— 22.0
Acres per person on farm	15	22	+ 45.4
Number of census farms	64,786	57,698	— 11.0
Acres per farm	69	94	+ 35.5
Number of operating units	46,009	48,348	+ 6.8
Acres per operating unit	98	112	+ 14.9
Number of cropper units	18,777	9,350	— 51.2
Farm organization:			
Acres cotton	680,910	322.530	— 52.6
Gallons whole milk sold	5,282,112	13,044,482	+147.0
Number all cattle and calves	206,926	358,242	+ 73.1
Number hogs and pigs	88,372	173,916	+ 96.8
Number tractors	1,449	8,570	+491.4

*Preliminary estimate.

Topography and soils in the area vary considerably. Generally, the land is rolling and highly susceptible to erosion. Soils are of the coastal plain origin. Soil texture is coarse and sandy in spots, fine and sticky in others. Natural fertility is generally low and large applications of commercial fertilizer are required to increase rates of production.

Sample Selection

Within each county in the area studied, a random sample of farms and rural residences was obtained by means of area sampling. A uniform sampling rate (about 3.4 percent of the rural area) was used in all counties. Hence, the number of cases studied in each county was about in proportion to the total number of electrified operating units in it.

Operating units that had received central-station service on or before January 1, 1949, were included in the study. Usable records were taken of 500 farms and 62 rural residences. Of these 466 were served by rural electric cooperatives, 50 by municipalities, and 46 by power companies.

Enumeration: Skilled enumerators obtained the farm information, usually from operators of individual farms or rural residences. The enumeration was made in July and August, 1950. Data on the consumption of electricity and costs were provided by the suppliers who served the individual farms.

In this study, croppers were considered as farm laborers, not as farm operators; their units were not handled as individual cases but were considered as a part of the operating unit on which they worked. Share and cash renters were considered as operators. Their farms were handled as individual cases in the analysis of the data.

Presentation of data: The general plan of presenting the data is similar to that used in the studies in other states. This is done so that certain comparisons may be made of the data from those studies. Class designations used by the Census of Agriculture are followed as nearly as practicable to permit comparisons with Census data.

All of the electricity consumed on an individual farm—whether in the operator's home, a labor's home, or in the service buildings—is considered as used by that farm. Most farms had only one dwelling that used electricity, but some (16.6 percent) had two or more. In this respect, the data as presented in this report are not entirely comparable to the data usually published by suppliers. Suppliers usually report consumption "per consumer" or "per customer" rather than "per farm."

Rural residences handled separately: As mentioned earlier, all operating units within a sample area were included in the study. This resulted in including a number of cases that were not farms by any standard, but were rural residences. They embraced very small acreages and the operators generally were employed in town or were retired. Consequently, data from farms and rural residences are handled in separate sections in this report. For this purpose a rural residence is defined as any unit of less than three acres and with agricultural production of less than $250.

USE OF ELECTRICITY ON FARMS

It has been shown in other studies, and it is borne out in this study, that the amount of electricity used per farm in certain localities is principally a function of three factors. The factors are time, income, and size of specific farm enterprises, particularly those enterprises which use large amounts of electric energy, such as dairy businesses. Time is necessary for the farmer to become acquainted with the potentialities of electricity on the farm and to acquire various equipment available for his use. An adequate income is necessary if he is to buy electrical appliances. He must have a sizeable business to have need for many kinds of equipment for use in farming operations.

This study indicates, however, that

two other considerations may also have strong influences. These are the rate structures under which electricity is sold and the tenure of the farm operator. Furthermore, farms appear to vary widely in the amount of use given specific kinds of equipment. Consumption records indicate that some farmers use equipment extensively while other farmers make restricted use of theirs.

All of these characteristics are examined more fully in the following paragraphs.

Upward Trend in Consumption

From 1940 to 1949, the average amount of electricity used annually by farms in this study rose from 565 kilowatt-hours in 1940 to 1,494 in 1949 (Table 2). The increase was at an average rate of 12.5 percent annually,[3] but it was somewhat more rapid in the last half of the decade than in the first. No doubt part of this difference in the rate of increase was due to better economic conditions and greater availability of electrical equipment in recent years. To a large extent, however, it indicates that farm people want such equipment and buy it rather rapidly.

While the amount of electricity used per farm has increased substantially, the number of farms with electric service has also increased. Reports of the Bureau of the Census indicate that in 1940 there were 5,007 electrified farms in the 19 counties. The number had almost doubled by 1945, reaching 9,953. By January 1, 1949, about 26,000 farms (by the definition used in this study) had central-station electric service. Consequently, the total amount of electricity used by all farms in the area increased from about 2,800,000 kilowatt-hours in 1940 to 38,800,000 in 1949. The total amount paid for this electricity rose from about $150,000 in 1940 to $1,221,000 in 1949.

Data presented in Table 2 reveal two broad tendencies among farms in this study. First, farms as a rule used greater amounts of electricity as time went on, after they first received central-station electric service. For example, farms electrified in 1940 increased their average consumption from 409 kilowatt-hours in 1941 to 1,918 in

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[3] A fitted trend curve $Yc = 457\ (1.125x)$; $1940 = O$. Yc is the calculated kilowatt-hours and x is the number of years after 1940. The straight line trend is $Yc = 371 + 101x$ with the same base year.

Table 2. Average consumption of electricity per farm by year of electrification, 1940-1949.

	Consumption year									
Year electrified	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949
	Kilowatt-hours									
Before 1939	911	757	757	941	989	973	1,171	1,409	2,568	2,217
1939	306	353	392	335	399	602	891	1,032	1,261	1,660
1940	—	409	451	547	659	763	1,089	1,332	1,588	1,918
1941	—	—	648	917	901	1,008	1,327	1,402	1,837	2,429
1942	—	—	—	619	709	694	1,089	1,298	1,904	2,358
1943	—	—	—	—	591	541	623	949	1,517	2,222
1944	—	—	—	—	—	461	571	683	947	1,118
1945	—	—	—	—	—	—	445	543	796	1,068
1946	—	—	—	—	—	—	—	660	1,032	1,465
1947	—	—	—	—	—	—	—	—	907	1,320
1948	—	—	—	—	—	—	—	—	—	1,145
All years	565	452	543	675	728	710	855	961	1,268	1,494
	Farms represented									
	Number									
Before 1939	6	7	8	9	10	17	17	17	19	26
1939	8	8	8	10	10	15	15	15	15	15
1940	—	32	34	34	34	43	45	46	47	50
1941	—	—	25	25	26	30	30	30	30	30
1942	—	—	—	13	14	18	19	20	21	22
1943	—	—	—	—	9	12	12	12	12	13
1944	—	—	—	—	—	47	46	47	47	47
1945	—	—	—	—	—	—	47	49	50	52
1946	—	—	—	—	—	—	—	42	45	45
1947	—	—	—	—	—	—	—	—	66	69
1948	—	—	—	—	—	—	—	—	—	131
All years	14	47	75	91	103	182	231	278	352	500

Table 3. Electricity used per farm, 1949, and pieces of electrical equipment in use per 100 electrified farms by period of electrification, sub-area, tenure of operator and income group, August, 1950.

Item	All farms	Period of electrification			Sub-area			Tenure of Operator			Income group[3]		
		Before 1943	1943-1945	1946-1949	North	Central	South	Owner	Cash renter	Share renter	Low	Medium	High
							Number						
Farms represented	500	143	112	245	144	129	227	441	20	39	150	248	102
Kilowatt-hours used per farm, 1949	1,494	2,120	1,223	1,253	1, 757	1,372	1,394	1,588	897	724	869	1,287	2,918
Electric equipment per 100 farms for:													
Household operations:													
"Heavy" appliances[1]	35	50	30	28	40	34	32	39	10	3	20	28	72
"Light" appliances[2]	539	651	526	479	553	535	532	556	395	415	425	500	801
Total household operations	574	701	556	507	593	569	564	595	405	418	445	528	873
Water supply:													
Pressure system	36	57	35	24	23	29	48	41	—	—	27	30	64
Farm operations:													
Farm shop	10	17	11	8	4	15	12	11	—	—	2	9	28
Dairy	6	15	—	3	6	1	9	7	—	—	—	—	27
Poultry	9	15	4	7	9	9	9	10	—	3	5	11	9
Livestock	2	2	1	3	3	2	2	3	—	—	2	2	2
General	1	2	—	1	1	3	—	1	—	—	—	1	3
Total farm operations	28	51	16	22	23	30	32	32	—	3	9	23	69
Grand total, all uses	638	809	607	553	639	628	644	668	405	421	481	581	1,006

[1] Ranges, water heaters, home (food) freezers and air conditioning units.

[2] All other equipment used in household operation.

[3] Low income under $2,000 total (1949) income; medium, $2,000 to $3,999; high, $4,000 and over.

1949. The year-by-year increase in consumption per farm for the farms in this group was at a fairly constant rate of about 22 percent. For another example, farms electrified in 1944 used an average of 461 kilowatt-hours per farm in 1945 as compared to 1,102 kilowatt-hours in 1949. This group of farms increased their average consumption at the rate of about 25 percent annually.

The second broad tendency shown by these data is that farms electrified in recent years use less electricity than those that first received the service a number of years ago. The 143 farms electrified before 1943 used an average of 2,120 kilowatt-hours in 1949 compared to 1,242 kilowatt-hours for the 357 farms that first received the service after 1942.

No consistent association was found between year of electrification and amount of electricity used the first year. This inconsistency may be attributed largely to war-time circumstances which created a shortage of certain equipment. The trend in electricity used the first year of electrification was upward for units electrified from 1939 to 1942, downward for those electrified during the war years 1943 to 1945, and upward again for those electrified from 1946 to 1949. It is probable that those connected in the next few years will use a little more electric energy during their first year than was the case during the decade of record. Farm people have gained much from the experience of their neighbors; they will not need to go through the same long process of adaptation.

Some differences are found between the group of farms electrified before 1943 and those connected after that time. In the older group, there were more dairy farms and a larger proportion with high incomes. These differences account for some of the differences in average consumption, but they cannot account for all of them. Some of the higher consumption by farms electrified a number of years ago must certainly be due to the longer time during which farmers could become acquainted with the potentialities of electricity and electrical equipment and could install the desired equipment.

Electric equipment added gradually: Farms electrified before 1943 had about 42 percent more electric equipment per farm than did those connected after that time (Table 3). The differences were especially noticeable in ranges, water heaters, water systems and equipment used in the dairy and poultry enterprises. But they also had more of the smaller kinds such as radios, irons, clocks and toasters. The older group averaged about 6.5 pieces of "light" equipment per farm at the time of the survey as compared to 4.8 pieces per farm among farms connected more recently.

An average of 5.7 kinds of household appliances was in use per farm (Table 4). Of the three age groups, the earlier electrified farms had the greater number of kinds, averaging seven per farm. Farms electrified from 1943 to 1945 had an average of 5.6 kinds of appliances per farm, and those connected since then about 5. Forty-six percent of the older electrified farms had from six to ten different kinds of appliances, while the middle and recent time groups had mostly from three to five different kinds. Farms in the northern counties had a slightly larger number of kinds of appliances, 5.9 per farm as compared to 5.7 in each of the other groups.

The more commonly found household appliances were irons, radios, and refrigerators, in that order. Slightly over 96 percent of all farms had electric

Table 4. Household equipment per farm and percentage of farms having specified kinds, by date of electrification, July, 1950.

Item	Unit	Date of electrification			
		Before 1943	1943-1945	1946-1949	All farms
Farms represented	Number	143.0	112.0	245.0	500.0
Equipment per farm	Percent	7.0	5.6	5.0	5.7
Farms with equipment:					
Less than 3 different kinds	Percent	3.5	7.1	15.5	10.2
3 to 5 different kinds	do.	44.8	55.4	55.9	52.6
6 to 10 different kinds	do.	46.2	35.7	27.8	34.8
11 or more different kinds	do.	5.5	1.8	.8	2.4

irons, 92 percent had radios, and 87 percent had refrigerators (Appendix Table 1). Washing machines were numerous, with more than 57 percent of the farms owning one. Household fans were reported by 43 percent and hot plates by 28 percent. Electric ranges were used on 22 percent of the farms. One farm reported a television set, and two had air conditioning units. Less than 5 percent had home freezers.

Less than a third of the 500 farms in this study reported any equipment for use in farming operations. Almost half of the equipment was reported by the 143 farms electrified before 1943. Only 2 percent of the farms had an electrically operated milking machine and 9 percent had an electric brooder hover for chicks.

Twenty farms reported some kind of shop equipment using electric energy. They reported 50 pieces. The most numerous piece of equipment was the tool grinder—and fewer than 3 percent reported that. Three percent had an electrically driven saw. Less than 1 percent had such equipment as air compressors, drill presses, lathes, and welders.

Wide variations among farms: There was little tendency for farms to be "average" in the use of electricity. For example, the average consumption of the 143 farms electrified before 1943 was 2,120 kilowatt-hours in 1949, but only six farms used within 200 kilowatt-hours of the average. The median for the group was 1,027 kilowatt-hours; or, to consider the extremes, 11 farms of this older electrified group used less than 400 kilowatt-hours in 1949 while 12 others used 5,000 or more (Table 5). It is evident that the average consumption for the group was strongly influenced by a few high-consuming farms.

Farms first connected in 1943 and later years also varied widely in the use of electricity. Almost two-thirds of these farms used less than 1,000 kilowatt-hours in 1949, while 6 percent used 4,000 or more. However, relatively more of the farms electrified recently were in the low-consuming brackets than of the farms that had received service before 1943.

No seasonal trend: No seasonal pattern was apparent in the monthly consumption data for any given year (Table 6). In fact, kilowatt-hour usage was

Table 5. Distribution of farms by electricity used in 1949, by date of electrification.

Kilowatt-hours used in 1949	Date of electrification				Date of electrification			
	Before 1943	1943-1945	1946-1949	All years	Before 1943	1943-1945	1946-1949	All years
	Number				Percent			
Less than 200	1	2	7	10	0.7	1.8	2.8	2.0
200 to 399	10	14	32	56	7.0	12.5	13.1	11.2
400 to 599	14	19	36	69	9.8	17.0	14.7	13.8
600 to 799	23	20	43	86	16.1	17.8	17.6	17.2
800 to 999	20	20	42	82	14.0	17.8	17.2	16.4
1,000 to 1,999	29	20	49	98	20.2	17.8	20.0	19.6
2,000 to 2,999	9	5	17	31	6.3	4.5	6.9	6.2
3,000 to 3,999	11	4	7	22	7.7	3.6	2.8	4.4
4,000 to 4,999	14	4	5	23	9.8	3.6	2.1	4.6
5,000 or more	12	4	7	23	8.4	3.6	2.8	4.6
All farms	143	112	245	500	100.0	100.0	100.0	100.0

Table 6. Average consumption of electric energy on farms, by period of electrification, by months, 1940, 1945, and 1949.

Month	Period of electrification						All farms		
	Before 1943			1943-1945		1946-49			
	1940	1945	1949	1945	1949	1949	1940	1945	1949
	Kilowatt-hours								
January	53	71	177	43	96	92	53	62	117
February	45	73	180	39	92	91	45	62	117
March	41	62	177	38	87	91	41	54	115
April	45	73	177	39	89	96	45	62	117
May	38	64	159	38	103	90	38	55	113
June	41	71	160	37	98	96	41	59	115
July	38	72	184	38	111	109	38	60	131
August	44	67	167	37	119	109	44	56	128
September	41	78	168	40	115	108	41	64	127
October	36	74	170	35	104	104	36	59	123
November	38	72	180	43	100	112	38	60	128
December	35	87	204	45	98	121	35	71	139

fairly uniform throughout the year in 1940, 1945, and 1949. Absence of a seasonal pattern may be due to several reasons, among which are: (1) addition of equipment during the year; (2) movement of tenants and croppers during the year; and (3) uses that cause conflicting patterns to develop. For example, the use of electricity for lighting and home heating is no doubt heavier in winter, while use for milking is heavier in summer when milk production is higher. The pattern depends a great deal upon the uses and as these vary throughout the area. It is doubtful whether a decided seasonal pattern will soon develop.

In 1949, consumption of electric energy was highest in December and July, and lowest in May. An average of 122 kilowatt-hours was used per month in 1949.

More Electricity Used Where Rates Are Low

Subdivisions of study area: As the analysis progressed, it became apparent that for some purposes the study area should be divided into three geographic sub-areas or sections—Northern, Central and Southern. Three main differences led to this conclusion. (1) The cost per kwh of electricity to the farmer was lower in the northern part than in the southern. In the northern section farmers paid an average of 2.5 cents per kilowatt-hour used while those in the central section paid 3.2 cents, and those in southern counties paid 3.8 cents. The average cost to all units studied was 3.2 cents per kilowatt-hour. (2) Industry provides more off-farm employment in the southern part than in the northern. (3) Electrification of farms has spread more slowly in the central counties. In 1940, only 4 percent of the farms in the central counties were connected for electricity, as compared to 11 percent of the northern counties and 8 percent of the farms in southern counties. The following data show the progress of farm electrification in the areas since 1940. Gains since 1945 in all sections are especially noteworthy.

Section	Percent of farms electrified		
	1940	1945	1950
Northern counties	11.0	17.9	53.6
Central counties	4.4	15.7	59.9
Southern counties	8.4	17.9	58.7
Clay Hills area	8.1	17.6	57.3
State of Mississippi	9.5	18.6	55.7

The three subdivisions with the counties included in each group are: Northern group—Benton, Lafayette, Marshall, Pontotoc, Tippah and Union; Central group — Attala, Calhoun, Choctaw, Montgomery, Webster and Winston; and the Southern group—Clarke, Kemper, Lauderdale, Leake, Neshoba, Newton, and Scott.

Average consumption highest in northern counties: The average consumption of farms in the 6 northern counties was 1,757 kilowatt-hours in 1949. This was 27 percent more than the average of 1,386 kilowatt-hours used by farms in the 13 central and southern counties.

Throughout the decade of record, farms in the northern counties used more electricity per farm than did farms in the southern group of counties (Table 7). However, farms in the southern counties have rather consistently increased their average at the rate of about 20 percent per year while most of the increase in the northern counties took place in the three years 1947-49. The numbers of records avail-

Table 7. Consumption of electric energy per farm by sub-areas, 1940-49.

Year	Sub-area			Study area
	North	Central	South	
		Kilowatt-hours		
1940	988	—	248	565
1941	990	516	309	452
1942	870	836	361	543
1943	1,012	1,110	435	675
1944	1,037	1,021	512	728
1945	835	995	571	710
1946	905	1,190	712	855
1947	1,106	1,129	854	961
1948	1,701	1,294	1,075	1,268
1949	1,757	1,372	1,394	1,494
		Farms represented		
		Number		
1940	6	—	8	14
1941	8	6	33	47
1942	10	18	47	75
1943	14	21	56	91
1944	22	22	59	103
1945	41	34	107	182
1946	52	48	131	231
1947	61	61	156	278
1948	76	93	183	352
1949	144	129	227	500

able for the first half of the decade are not sufficiently adequate to be statistically conclusive, yet there are enough to indicate the trends.

Characteristics of electrified farms: Farms in the central section had an average of 121 acres per farm while northern farms had 104, and southern farms, 93 acres (Table 8). All farms averaged 103 acres. Cropland constituted about a third of all land; cotton and corn were the principal crops. There was an average for all farms of 8.2 animal units,[4] with no significant difference between sections in livestock numbers per farm.

Total incomes[5] averaged $3,300 in 1949, about half of which was from farm sales, one-sixth from the home use of products produced on the farm, and more than a third from off-farm employment. Sales of cotton made up about half of total farm sales in the area. Cotton was most important in the northern section, where it constituted two-thirds of total farm sales. In

Table 8. Characteristics of electrified farms, by sub-areas, 1949.

Characteristic	Unit	Sub-area			Study area
		North	Central	South	
Farms represented	Number	144	129	227	500
Average per farm:					
Consumption of electricity	KWH	1,757	1,372	1,394	1,494
Cost of electricity used	Dollars	44.49	44.37	52.28	46.96
Acreage operated	Acres	104	121	93	103
Acreage in crops:	do.	33.7	34.7	29.2	31.9
Cotton	do.	14.1	10.7	7.9	10.4
Corn	do.	13.4	16.8	13.3	14.2
Lespedeza	do.	3.7	4.4	2.1	3.2
Income (Gross):					
Farm sales	Dollars	2,047	1,489	1,448	1,631
Cotton	do.	1,367	814	582	868
Products used in home	do.	496	466	443	464
Off-farm	do.	972	1,061	1,496	1,233
Total	do.	3,515	3,016	3,387	3,328
Animal units	Number	8.3	8.2	8.3	8.2
Wired dwellings	Dollars	1.4	1.3	1.2	1.3
Cost of electricity per $1,000 total income	Dollars	12.66	14.71	15.44	14.09
System of farming:					
Cotton	Percent	61	37	31	41
Dairy	do.	10	7	5	7
Livestock	do.	3	7	9	7
Poultry	do.	—	—	4	2
General	do.	7	11	7	8
Part-time	do.	13	21	35	25
Subsistence	do.	6	17	9	10
Size of farm:					
Less than 30 acres	do.	18	13	23	19
30 to 69 acres	do.	33	28	27	29
70 to 139 acres	do.	26	31	31	30
140 to 259 acres	do.	17	16	13	15
260 acres or more	do.	6	12	6	7
Total income:					
Less than $2,000	do.	29	38	26	30
$2,000 to $3,999	do.	52	44	51	50
$4,000 or more	do.	19	18	23	20
Date of electrification:					
Before 1943	do.	24	19	37	29
1943 to 1945	do.	23	19	24	22
1946 and after	do.	53	62	39	49
Tenure of operator:					
Owner	do.	74	94	94	88
Cash renter	do.	6	1	5	4
Share renter	do.	20	5	1	8
Farms with:					
1 dwelling	do.	82	82	86	84
2 dwellings	do.	12	13	10	11
3 or more dwellings	do.	6	5	4	5

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[4] The following animal unit conversion factors, as suggested by R. D. Jennings of the Bureau of Agricultural Economics, were used: Milk cow, .7; milk heifer, .3; beef cow, .5; other cattle and calves, .3; pigs raised, .13; feeder pigs bought, .10; hens and pullets, .01; chicks raised, .0035; turkeys raised, .02; and horses and mules, .9.

[5] This is gross receipts with no deductions for expenses. It is not necessarily closely related to net income or disposable income. However, it is one measure of the size of the farm business and an indication of disposable family income.

the southern counties, sales of cotton comprised less than one-third of total sales. Off-farm income was most important in the southern section, making up 44 percent of total income in those counties. The importance of off-farm employment in southern counties is further pointed up by the large proportion (35 percent) of part-time farmers. Of course, the larger off-farm employment, and preponderance of part-time farms, are corollary to heavier industrialization in the southern section.

Because of the high off-farm income, total income for family living probably was slightly higher in southern counties than in other sections. Income from off-farm employment largely represents a net amount available for family living. Income from farm sales does not represent disposable income or income for family living, but rather the gross amount received and available to pay production costs as well as family living expenses. Actually, the gross receipts for some individual farms in some years may not be large enough to pay the farm costs, resulting in a negative income to the family. Income from off the farm, therefore, is much more significant from the family living standpoint than is a like amount from farm sales.

Sixty-one percent of the northern farms were classified as cotton farms,[6] while only 37 percent of central and 31 percent of southern farms, were of this system. Dairying was relatively minor, as only 7 percent of all farms in the survey were classified as dairy. Dairying was most important among farms in the northern group of counties. Livestock farms, like dairy, made up 7 percent of all farms, but were more prevalent in the southern counties. A little more than 10 percent of all farms were subsistence farms, with the preponderance in the central counties, where 17 percent of all farms were of that classification.

Southern farms, with 37 percent electrified before 1943, were electrified earlier than farms in the other sections. More than half of the farms in the central and northern sections were electrified from 1946 to 1949, while only 39 percent of those in the southern section were electrified in that recent period.

By all the characteristics outlined, it would seem that consumption of electricity would be higher in the southern than in the other sections, yet consumption was highest in the northern counties, and by a significant amount. Income is slightly higher in the southern counties, and farms in the southern counties were electrified earlier on the average. Those two factors, as pointed out in succeeding sections, have an important relationship to kilowatt-hour consumption. However, the cost of electricity to farmers was lower in the northern group of counties. This explains at least a part of the higher average consumption in the northern counties. Northern farms paid 2.5 cents per kilowatt-hour used in 1949, while central farms paid 3.2 cents, and southern farms, 3.8 cents. Rate structures are set up so that average costs decline with amount of electricity used. Consequently, a lower average unit cost would naturally be expected where more is used. Basically, however, cost rates in the northern section are lower than in most parts of the central and southern sections. The average expense for electricity for all farms was $47 in 1949, or about $4 a month, with southern farmers having the highest average expense, $52 a year.[7]

Equipment inventories differ: The higher average consumption by farms in the northern group of counties cannot be entirely accounted for by the equipment reported. Farms in the northern counties did report more household equipment, particularly ranges and water heaters. But almost half of the southern farms had pressure water systems (electric) while less than a fourth of the farms in the northern counties had such systems. Equipment for use in farming operations was not numerous in any of the sub-areas (Table 3).

The amount of use made of equipment installed is apparently another facet of the situation Available data in this regard are not conclusive. Nevertheless the individual farm schedules indicate that farmers in the northern counties used their electrical equipment more than did farmers in the southern counties.

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[6] See page 20 for a description of criteria used in classification.

[7] See Table 24 for more data on costs.

Large Farms Use More Electricity

Eight size-of-farm groups were established, so that the relationship between size of farm and use of electric energy could be ascertained (Table 9). These groups, based on total acres of land under operation, were: less than 9, 10 to 29, 30 to 49, 50 to 69, 70 to 139, 140 to 259, 260 to 379, and 380 or more acres. These acreage intervals were chosen because they are used by the census, and they permit visual examination of the relationships under study. Other measures of size, such as acres of cropland, acres of cotton, gross farm income, and number of animal units, varied directly with total acres operated.

Except for farms with less than nine acres, kilowatt-hour consumption in 1949 ranged directly from 1,257 for farms with from 10 to 29 acres, to 3,991 for those with 380 or more acres of land. The failure of the group with less than nine acres to follow the pattern may be attributed to off-farm income and other factors, rather than size. The total income of this group of small farms was relatively high, with 89 percent coming from off-farm sources. The proportion of total income from off-farm sources declined with increased size of farm, while both farm sales and value of products used in the home increased with size.

A factor that may help to explain the relatively high consumption by the smallest size group is the length of time the farms had been electrified. A high-

Table 9. Characteristics of electrified farms, by size of farm, 1949.

Characteristic	Unit	Acres operated							
		9 or less	10-29	30-49	50-69	70-139	140-259	260-379	380 or more
Farms represented	Number	35	60	79	68	147	74	22	15
Average per farm:									
Consumption of electricity	Kwh	1,493	1,257	1,109	1,191	1,405	1,725	2,545	3,991
Acreage operated	Acre	5	18	39	58	99	182	291	590
Acreage in crops:	do.	1.5	8.6	15.0	22.0	33.4	52.5	63.0	169.4
Cotton	do.	0.1	2.5	4.7	8.2	10.2	19.5	20.4	47.9
Corn	do.	0.3	4.5	7.9	10.1	16.7	23.0	25.2	56.0
Lespedeza	do.	—	0.3	1.2	2.3	3.1	4.4	13.0	15.7
Income (gross):									
Farm sales	Dollar	38	435	932	1,132	1,472	3,045	3,380	8,100
Cotton	do.	2	242	414	720	723	1,590	1,555	5,304
Products used in home	do.	242	329	366	400	481	631	647	1,076
Off-farm	do.	2,188	1,414	1,273	1,116	1,093	967	904	1,761
Total	do.	2,468	2,178	2,571	2,648	3,046	4,643	4,931	10,937
Animal units	Number	1.1	3.0	5.0	5.6	9.0	12.4	19.1	31.3
Wired dwellings	do.	1.0	1.0	1.1	1.1	1.2	1.6	1.9	4.0
System of farming:									
Cotton	Percent	—	25	39	57	44	53	45	54
Dairy	do.	—	3	2	5	10	10	14	13
Livestock	do.	—	2	3	6	10	11	9	13
Poultry	do.	—	2	4	—	2	1	5	—
General	do.	—	—	5	7	11	16	14	7
Part-time	do.	86	46	32	15	16	5	9	13
Subsistence	do.	14	22	15	10	7	4	4	—
Total income:									
Less than $2,000	do.	31	47	39	35	28	11	27	7
$2,000 to $3,999	do.	60	50	55	50	52	50	18	20
$4,000 and over	do.	9	3	6	15	20	39	55	73
Date of electrification:									
Before 1943	do.	37	27	24	29	24	35	27	53
1943 to 1945	do.	26	28	23	24	21	20	23	7
1946 and after	do.	37	45	53	47	55	45	50	40
Tenure:									
Owner	do.	91	84	82	84	91	92	91	100
Cash renter	do.	9	8	5	—	2	4	9	—
Share renter	do.	—	8	13	16	7	4	—	—
Farms with:									
1 dwelling	do.	94	95	94	90	86	65	59	33
2 dwellings	do.	6	5	6	10	13	19	14	20
3 or more dwellings	do.	—	—	—	—	1	16	27	47

Table 10. Electricity used per farm, 1949, and pieces of electrical equipment in use per 100 electrified farms, by system of farming and size of farm, August, 1950.

Item	Size of farm					System of farming						
	Under 30 acres	30-69 acres	70-139 acres	140-259 acres	260 acres and over	Cotton	Dairy	Live-stock	General	Poultry	Part-time	Sub-sistence
Farms represented	95	147	147	74	37	207	34	34	41	9	124	51
Kilowatt-hours used per farm, 1949	1,344	1,147	1,405	1,725	3,131	1,416	2,773	1,968	1,545	870	1,426	864
Electrical equipment for household operations:												
"Heavy" appliances[1]	30	28	25	53	73	30	56	65	39	—	35	22
"Light" appliances[2]	434	499	518	628	873	570	576	573	632	500	510	366
Total, household operations	464	527	543	681	946	600	632	638	671	500	545	388
Water supply:												
Pressure system	36	23	37	49	57	29	41	50	56	33	42	20
Farm operations:												
Farm shop	1	9	18	8	16	10	12	3	10	—	14	4
Dairy	—	—	6	11	33	—	85	—	—	—	—	—
Poultry	6	9	9	10	11	8	12	21	15	—	8	—
Livestock	1	3	2	1	5	2	6	—	2	—	2	—
General	1	—	1	1	8	1	3	—	2	—	2	—
Total, farm operations	9	21	36	31	73	21	118	24	29	—	26	4
Grand total, all uses	509	571	616	761	1,076	650	791	712	746	533	613	412

[1] Ranges, water heaters, home (food) freezers and air conditioning units.

[2] All other equipment used for household operations.

er proportion of the small farms were electrified before 1943 than for any except the largest farm group. Many of these small places were close to urban centers and so were easily reached by distribution lines.

Slightly over 85 percent of the smallest farms were classified as part-time farms. Most of the farms with more than 30 acres were cotton farms. The largest percentage of cotton farms was in the 50 to 69 acre group. Percentages of dairy and livestock farms increased with size, and the importance of subsistence farms declined as acres operated increased.

From 80 to 90 percent of farms in all size groups were owner operated. Tenancy was most important on farms from 10 to 70 acres in size. None of the larger farms were operated by tenants, although there was a good deal of share cropping on these farms, as indicated by the number with three or more dwellings.

Large farms have more equipment: Large farms had more household equipment of nearly all kinds than did the small ones (Table 10). This was especially true of such equipment as ranges, water heaters, home freezers, and washing machines (Appendix Table 2). Practically all farms had at least one radio and one electric hand iron, but the large farms commonly had two or more of each. The 37 farms of 260 acres or more had 81 radios, 67 irons, and 54 electric refrigerators.

The number of pieces of household equipment per farm ranged from 4.6 on farms of less than 30 acres to 9.5 on farms of 260 acres or more. Variety of equipment used was also greatest on the large farms. Sixty-two percent of the farms of 260 or more acres had six or more different kinds of household equipment, while only 32 to 43 percent of the farms in the other size groups had as many. Most farms had from three to five different kinds (Table 11).

Large farms also had more equipment for use in farming operations than did the small ones. The 95 farms of less than 30 acres reported only nine pieces of such equipment—six chick brooder hovers, one fence controller, one sander, and one wood saw. But the 37 farms of 260 acres or more had 27 pieces of farm equipment, 12 of them for use in the dairy enterprise.

Individual farm differences: Although there was a tendency for farms to use, by average, more electricity as the size of farm increased, the correlation between acres operated and kilowatt-hours used on individual farms in 1949 was negligible.[8]

Within each of the size-of-farm group the amount of electricity used by individual farms varied widely (Table 12). Thirty percent of the farms of 260 acres and more used less than 1,000 kilowatt-hours in 1949, while 16 percent used 5,000 or more. All the other size groups had wide variations among individual farms, but with greater concentration of farms in the groups using less than 1,000 kilowatt-hours during the year.

The reasons for these variations among farms similar in size are not entirely clear. Apparently two factors were influential. First, the correlation between acres operated and total income was only fair.[9] Second, the bulk of the electricity was used for household purposes. Even in the largest size-of-farm group, about 80 percent of the electricity consumed was used in household operations. The amount of electricity used outside the home was more closely related to the size of the dairy herd than to acres operated.

Effect of System of Farming

Basis for classification: Farms in the survey were classified according to the following procedure into various systems, based upon census criteria with certain adaptations:

A. Tracts of 3 or more acres and the value of home-use products larger than product sales.

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[8] A regression equation of 1949 kilowatt-hour consumption on 1949 acres operated for 140 farms electrified in 1942 and before is $Yc = 1780 + 1.622\ X$ with a coefficient of correlation $r = + .13$. The calculated kilowatt-hours is indicated by Yc and X represents the acres operated.

[9] A regression equation of 1949 gross farm income on acres operated in 1949, $Yc = 810 + 12.05\ X$ with a coefficient of correlation, $r = + .63$. The calculated income is indicated by Yc and X represents the acres operated.

Table 11. Household equipment per farm and percentage of farms having specified kinds, by size of farm, July, 1950.

Item	Unit	Acres operated				
		Less than 30	30 to 69	70 to 139	140 to 259	260 or more
Farms represented	Number	95	147	147	74	37
Equipment per farm	Pieces	4.6	5.3	5.4	6.8	9.5
Farms with kinds of equipment:						
Less than 3	Percent	22.1	8.8	6.1	6.8	8.1
3 to 5	do.	45.3	53.8	63.3	50.0	29.7
6 to 10	do.	30.5	36.7	28.6	39.2	54.1
11 or more	do.	2.1	0.7	2.0	4.0	8.1

Table 12. Distribution of farms by electricity used and by acres operated in 1949.

Acres operated	Kilowatt-hours used, 1949						
	Less than 1,000	1,000 to 1,999	2,000 to 2,999	3,000 to 3,999	4,000 to 4,999	5,000 & over	All farms
	Percent						
Less than 30 acres	67.4	12.6	4.2	5.3	6.3	4.2	100
30 to 69 acres	68.7	17.7	4.8	3.4	3.4	2.0	100
70 to 139 acres	61.8	21.8	8.2	3.4	1.4	3.4	100
140 to 259 acres	50.0	24.3	8.1	5.4	5.4	6.8	100
260 acres and over	29.7	24.4	5.4	8.1	16.2	16.2	100
All farms	60.6	19.6	6.2	4.4	4.6	4.6	100

1. **Subsistence farms**—Less than $1,200 total income (agricultural production plus off-farm income.)
2. **Part-time farms**—$1,200 or more total income (agricultural production plus off-farm income).

B. Tracts of 3 or more acres and product sales larger than the value of home-use products.

1. **Cotton farms**—sales from cotton (lint and seed) more than 50 percent of agricultural production.
2. **Dairy farms**—sales from milk and other dairy products more than 50 percent of agricultural production.
3. **Livestock farms**—sales from livestock more than 50 percent of agricultural production.
4. **General farms**—sales from crops and livestock so diversified that farms would not classify among the other systems.
5. **Poultry farms**—sales from poultry and poultry products more than 50 percent of agricultural production.

Cotton farms were most numerous, constituting 41 percent of all farms in the sample, followed by part-time farms, which made up 25 percent. Dairy, livestock, and general farms were about equally numerous, comprising 7, 7, and 8 percent, respectively, of the total. Ten percent were subsistence farms, and only 2 percent were poultry farms. Cotton farms were numerous in both the northern and central counties, making up 61 and 37 percent respectively, of farms in those sections (Table 8). In the southern counties, cotton farms were second in importance ranking behind part-time farms, which made up 35 percent of all farms. All poultry farms were in the southern section.

A definite relationship was found between size of farm and system of farming. Systems with large numbers of animal units—such as livestock, dairy, and general farms—generally operated larger acreages (Table 13). Livestock farms, the largest farms, averaged 155 acres and 17 animal units. Dairy farms, with 153 acres and 16 animal units, and the general farms, with 134 acres and 11 animal units, followed closely. Cotton and poultry farms, the more labor-intensive type of enterprises, were next in size while part-time and subsistence farms were smallest. The latter systems had an average of 58 acres of land under operation, only 12 acres of cropland, and 3 animal units. Acreages of cropland were largest on cotton farms.

Total income was largest ($7,159) on poultry farms, but so were operating expenses. Dairy farms, with $4,404, ranked second in total income, followed in order by cotton, livestock, gen-

Table 13. Characteristics of electrified farms, by system of farming, 1949.

Characteristic	Unit	System of farming: Cotton	Dairy	Live-stock	Gen-eral	Poul-try	Part-time	Sub-sistence
Farms represented	Number	207	34	34	41	9	124	51
Average per farm:								
Consumption of electricity	Kwh	1,416	2,773	1,968	1,545	870	1,426	864
Cost of electricity used	Dollars	44.68	61.67	61.96	54.39	44.57	45.86	33.56
Acreage operated	Number	119	153	155	134	102	58	58
Acreage in: Crops	Acres	49	38	24	39	10	13	12
Cotton	do.	20	6	2	10	1	1	2
Corn	do.	21	17	13	20	9	4	7
Lespedeza	do.	4	7	5	4	—	1	1
Incomes (gross):								
Farm sales	Dollars	2,382	3,228	1,717	1,837	5,620	129	247
Cotton	do.	1,836	352	140	594	132	46	120
Products used in home	do.	573	505	388	526	395	317	366
Off-farm	do.	907	671	1,494	839	1,144	2,339	398
Total	do.	3,862	4,404	3,599	3,202	7,159	2,785	1,011
Animal units	Number	9.0	16.1	17.2	11.3	14.3	3.0	3.8
Wired dwellings	Number	1.5	1.2	1.1	1.5	1.2	1.1	1.0
Cost of electricity per $1,000 total income	Dollars	11.57	14.00	17.22	24.70	6.23	16.47	33.19
Size of farm:								
Less than 10 acres	Percent	—	—	—	—	—	24	10
10 to 29 acres	do	7	6	3	—	11	23	25
30 to 69 acres	do.	34	14	18	22	34	28	37
70 to 139 acres	do.	31	44	44	39	33	19	20
140 to 259 acres	do.	19	21	23	29	11	3	6
260 acres or more	do.	9	15	12	10	11	3	2
Total income:								
Less than $2,000	do.	24	15	12	27	22	23	100
$2,000 to $3,999	do.	53	41	59	49	33	65	—
$4,000 and over	do.	23	44	29	24	45	12	—
Date of electrification:								
Before 1943	do.	26	35	41	27	22	31	21
1943 to 1945	do.	25	12	21	15	33	24	22
1946 and after	do.	49	53	38	58	45	45	57
Tenure:								
Owner	do.	79	94	100	98	78	94	92
Cash renter	do.	4	—	—	—	22	6	4
Share renter	do.	17	6	—	2	—	—	4
Farms with:								
1 dwelling	do.	75	85	91	68	78	93	98
2 dwellings	do.	16	15	3	20	22	6	2
3 dewellings or more	do.	9	—	6	12	—	1	—

eral, part-time, and subsistence farms. Total income on subsistence farms averaged only $1,011. Off-farm income was highest on part-time farms, comprising 84 percent of total income of farms in this group. It was least important on dairy farms. The work requirements of a dairy farm make it difficult for members of the family to work part-time at some other job.

Livestock farms were electrified earlier than farms of other systems—41 percent were connected to rural service lines before 1943. Dairy, part-time, and cotton systems were next in order of electrification, with subsistence and general farms the more recently electrified, as a rule.

Tenancy was most prevalent on cotton and poultry farms, with share renting predominant on cotton farms, and cash renting on poultry farms. All livestock farms and more than 90 percent of general, dairy, subsistence and part-time farms, were owner-operated.

Dwellings on farms were most numerous on general, cotton, and poultry farms. Livestock, subsistence, and part-time farms usually were one family operations. More than 90 percent of these farms had only one dwelling.

Dairy farms used most electricity: Dairy farms used more electricity per farm than those of any other system, 2,773 kilowatt-hours in 1949. They were followed in order by livestock, general, part-time, cotton, poultry, and subsistence farms. This indicates the influence of the farm enterprises on the amount of electricity used, as dairy farms did not rank first in size, income or in early farm electrification. Dairying was high in all of these attributes, however, and this, along with an extensive use of electricity for farm operations, accounts for the larger total consumption by these farms. Poultry farms used small amounts of electricity. There were only nine of these farms in the sample so the average should not be considered as conclusive. However, more operational use of electricity by these farms was for laying house lights, which required little electricity.

On the 500 farms in the survey, 29 pieces of dairy equipment were reported. These consisted of ten milking machines, ten milk coolers, eight water heaters (dairy) and one cream separator. All of this equipment was on the 34 dairy farms (Table 10).

The 41 general farms had 12 pieces of electrical equipment for use in farming operations. Six of these were chick brooders, five were shop equipment, and one was a wood saw. The 51 subsistence farms had two pieces of such equipment—one air compressor and one drill press.

Livestock farms had more of the "heavy" consuming kinds of household equipment than did those of any other system. General farms had more of the "light" consuming kinds. There is no clear indication as to why this situation existed.

The variety of household equipment in use was greatest on livestock farms. Fifty-six percent of them had six or more different kinds of equipment while only 20 percent of the subsistence farms had as many (Table 14).

Consumption Influenced by Tenure of Operator

In order to study the relationship of tenure of operator and farm electrification, farms in the study were classified into three groups—owners (including part-owners), cash renters, and share renters. In nearly all characteristics associated with large use of electricity, owners ranked first, cash renters second, and share renters third. Owners had larger farms, with 108 acres operated, as compared to 78 acres operated by cash renters and 67 acres by share renters. Owners had larger total incomes (and with a larger proportion of it from off-farm sources) with cash renters ranking second and share renters third. A larger proportion of owner farms were electrified before 1943 than either of the other tenure groups. Owner-operated farms used considerably more electric energy—more than twice as many kilowatt-hours in 1949 as were used on share renter farms. Farms operated by cash renters used slightly more electricity than those operated by share renters—897 kilowatt-hours and 724 respectively (Table 15).

Owner-operators have most equipment: Farms that were owner operated had virtually all of the electrical equipment used in farming operations that was reported. Of the 59 tenant-operated farms, one had an electric brooder for chicks. All of the 179 water systems were on the owner-operated farms (Table 3). A substantial part of these differences may be attributed to differences in the systems of farming practiced; for of the 59 tenant-operated farms, 56 were classified as cotton, poultry, part-time, or subsistence. As indicated previously, none of these used large amounts of electricity.

Owner-operated farms also had more of the equipment used in household operations, particularly those kinds that use relatively large amounts of electricity. Two of the 59 tenant-operated farms had electric ranges and 1 had a

Table 14. Household equipment per farm and percentage of farms having specified kinds, by system of farming, July, 1950.

Item	Unit	System of farming						
		Cotton	Dairy	Live-stock	Gen-eral	Poul-try	Part-time	Sub-sistence
Farms represented	Number	207	34	34	9	41	124	51
Equipment per farm	Pieces	6.0	6.4	6.4	5.0	6.8	5.4	3.9
Farms with different kinds of equipment:								
Less than 3	Percent	7.7	2.9	2.9	11.1	7.3	12.1	27.5
3 to 5	do.	58.9	53.0	41.2	77.8	43.9	46.0	52.9
6 to 10	do.	31.9	35.3	50.0	11.1	48.8	38.7	19.6
11 or more	do.	1.5	8.8	5.9	—	—	3.2	—

Table 15. Characteristics of electrified farms, by tenure of operator, 1949.

Characteristic	Unit	Tenure of operator		
		Owner	Cash renter	Share renter
Farms represented	Number	441	20	39
Average per farm:				
Consumption of electricity	Kwh	1,588	897	724
Cost of electricity used	Dollars	49.13	38.77	26.60
Acreage operated	Acres	108	78	67
Acreage in: Crops	do.	33	25	28
Cotton	do.	10	10	12
Corn	do.	15	10	14
Lespedeza	do.	3	1	2
Income (gross):				
Farm sales	Dollars	1,642	1,470	1,588
Cotton	do.	851	660	1,172
Products used in home	do.	474	408	385
Off-farm	do.	1,306	1,054	495
Total	Dollars	3,422	2,932	2,468
Animal units	Number	8.6	4.5	5.7
Wired dwellings	do.	1.3	1.2	1.0
Cost of electricity per $1,000 total income	Dollars	14.36	13.22	10.78
System of farming:				
Cotton	Percent	37	45	87
Dairy	do.	7	—	5
Livestock	do.	8	—	—
Poultry	do.	2	10	—
General	do.	9	—	3
Part-time	do.	27	35	—
Subsistence	do.	10	10	5
Size of farm:				
Less than 10 acres	do.	7	15	—
10 to 30 acres	do.	12	25	13
30 to 69 acres	do.	28	20	54
70 to 139 acres	do.	30	15	25
140 to 259 acres	do.	15	15	8
260 acres or more	do.	8	10	—
Total income:				
Less than $2,000	do.	29	35	36
$2,000 to $3,999	do.	49	55	56
$4,000 or more	do.	22	10	8
Date of electrification:				
Before 1943	do.	30	25	20
1943 to 1945	do.	21	35	26
1946 and after	do.	49	40	54
Farms with:				
1 dwelling	do.	82	80	100
2 dwellings	do.	12	20	—
3 or more dwellings	do.	6	—	—

food freezer. Twenty-five percent of the owner-operated farms had electric ranges and 5 percent had food freezers.

Income and the Use of Electricity Related

Income defined: In the preceding paragraphs mention has been made of the total or gross incomes of farms. In this study, farm income refers to the gross receipts of the farm both from the sale of farm products and from the value of farm products consumed in the home. No deduction is made for any farm expenses or taxes. Off-farm includes money from such sources as wages, rents and pensions. This also is a gross figure with no deductions for expenses incurred in obtaining the income.

For a study such as this, a "disposable" or "spendable" income figure would be more desirable. However, the time and expense required to obtain such a figure was considered too great to justify obtaining it. But within a restricted area and among farms of a similar type, those with relatively high gross incomes usually have relatively high net incomes. Consequently, the gross income figure may be considered an indication of relative disposable income and of the size of farm business. (See Footnote 9, page 20).

High income farms use more electricity: Farms with high incomes tended to use more electricity than did those with low incomes. For example, farms with total incomes of more than $4,000 used an average of 2,918 kilowatt-hours in 1949 while those with less than $2,000 total income used 869 kilowatt-hours (Table 16). This condition existed throughout the decade of record. (See Figure 2 and Appendix Table 5).

Several conditions accounted for these differences. High-income farms had more families per farm using electricity. The high-income group averaged 2.0 wired dwellings per farm, while the medium-income group averaged 1.2 and the low income group just 1.0. The high income farms had more livestock, about 4 times as many animal units per farm as the low income ones. They also included a higher proportion of dairy and livestock farms so they had more need for electrical equipment in the service buildings. All of the dairy equipment was on farms with high incomes (Table 3). In fact, the 102 farms with high incomes had more pieces of electrical equipment for use in farming operations than did all of the 398 farms with medium and low incomes.

Farms with high incomes also had more equipment for household operations, particularly of the "heavy consuming" kinds (Appendix Table 4).

The total number of household appliances per farm varied from 4 on low-income farms to 9 for high-income farms, (Table 17). Variety was also greater on high-income farms, with 60 percent reporting 6 or more different kinds of appliances, while only 34 percent of the medium-income and 27 percent of the low-income farms reported that many different kinds. Most farmers with less than $4,000 income had

Table 16. Characteristics of electrified farms, by income groups, 1949.

Characteristic	Unit	Income group [1]		
		Low	Medium	High
Farms represented	Number	150	248	102
Average per farm:				
Consumption of electricity	Kwh	869	1,287	2,918
Cost of electricity used	Dollars	34.38	43.27	74.45
Acreage operated	Acres	77	84	188
Acreage in: Crops	do.	19	24	69
Cotton	do.	5	8	25
Corn	do.	8	11	30
Lespedeza	do.	1	2	7
Income (gross):				
Farm sales	Dollars	546	1,064	4,604
Cotton	Dollars	318	591	2,351
Products used in home	Dollars	360	435	688
Off-farm	Dollars	529	1,275	2,164
Total	do.	1,435	2,774	7,456
Animal units	Number	4.4	6.7	17.7
Wired dwellings	do.	1.0	1.2	2.0
Cost of electricity per $1,000 total income	Dollars	23.96	15.60	10.02
System of farming:				
Cotton	Percent	33	44	47
Dairy	do.	3	6	15
Livestock	do.	3	8	10
Poultry	do.	1	1	4
General	do.	7	8	10
Part-time	do.	19	33	15
Subsistence	do.	33	*	—
Size of farm:				
Less than 30 acres	do.	26	20	5
30 to 69 acres	do.	37	31	15
70 to 139 acres	do.	27	31	29
140 to 259 acres	do.	5	15	28
260 acres or more	do.	5	3	23
Date of electrification:				
Before 1943	do.	21	26	46
1943 to 1945	do.	24	23	19
1946 and after	do.	55	51	35
Tenure:				
Owner	do.	86	87	95
Cash renter	do.	5	4	2
Share renter	do.	9	9	3
Farms with:				
1 dwelling	do.	97	86	57
2 dwellings	do.	3	11	24
3 or more dwellings	do.	1	2	19

[1] Low income under $2,000; medium $2,000 to $3,999; high $4,000 and over.
*Less than 0.5.

Table 17. Household equipment per farm and percentage of farms having specified types, by 1949 total income, July, 1950.

Item	Unit	Income		
		Less than $2,000	$2,000 to $3,999	$4,000 or more
Farms	Number	150	248	102
Appliances per farm	Pieces	4.4	5.3	8.7
Farms with different kinds of equipment:				
Less than 3	Percent	17.3	8.1	4.9
3 to 5	do.	56.0	58.1	34.3
6 to 10	do.	26.7	32.2	53.0
11 or more	do.	—	1.6	7.8

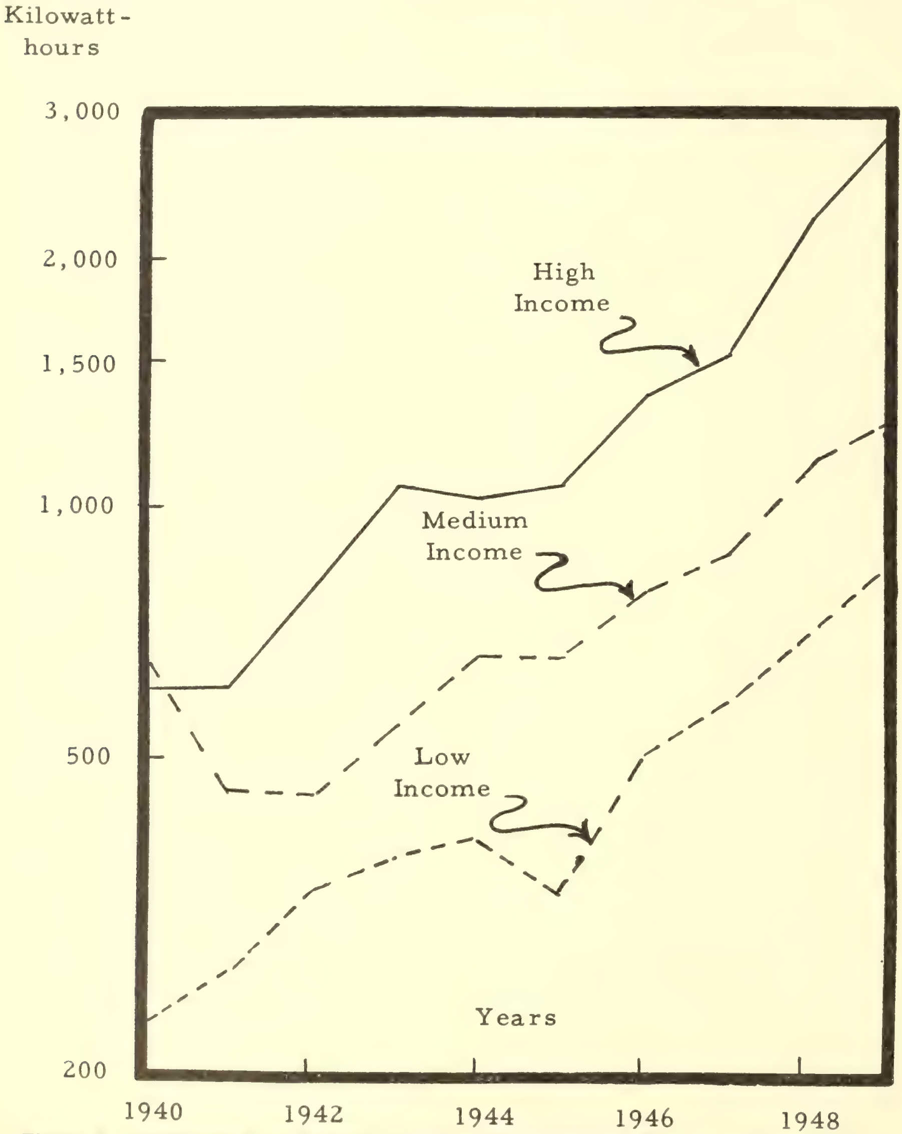

Figure 2. Consumption of electric energy per farm, by 1949 income groups, 1940-49.

from 3 to 5 different kinds of household appliances.

Wide variations among farms: Although there was a pronounced tendency for farms of high incomes to use more electricity than those with low incomes, few farms in any income group were average in this regard.[10] For example, of farms electrified before 1943 and in the southern group of counties, 17 had total incomes of $2,000 to $2,500. The average 1949 consumption of this group of farms was 1,331 kilowatt-hours but the range was from 233 to 4,198. In this group nine farms had total incomes of $3,000 to $3,500. They used an average of 1,731 kilowatt-hours but ranged from 320 to 4,770.

Several factors apparently played a part in causing these differences. Two of them deserve mention here. First, there is the individual preference for electric, gas, or some other equipment for cooking and water heating. This is discussed more fully in a following section. Second, individual farms vary widely in the amount of use given the electrical equipment. For many farms it is difficult to explain the actual consumption of electricity by the uses made of it. Four farms may be used to illustrate this situation.

In Lafayette county one farm used 336 kilowatt-hours in 1949 while another one only a few miles away used 1,105. The first farm was electrified in 1945 and had a 5-room house in good condition. The operator was 64 years of age and there were three other people in the household. The operator reported a refrigerator, an iron, a radio, and a household fan. The second farm was electrified in 1948 and had a 5-room house in fair condition. The operator was 63 years old with two other people in the household. The only electrical equipment reported by this operator was a refrigerator and an iron. The equipment reported would indicate that the first farm would use more electricity than the second.

In Pontotoc county one farm used 671 kilowatt-hours in 1949 and another used 4,245. Both were owner-operated cotton farms and were similar size and income. One had a 4-room dwelling, and the other five rooms. One operator was 60, the other 65. The electrical equipment reported by the first farmer consisted of radio, iron, refrigerator, washing machine, range, toaster, percolator, and household fan. The second farmer reported a radio, iron, refrigerator, washing machine, and range. Here again it would appear that the first farm would use more electricity than the second whereas actually it used only 16 percent as much.

With such wide variations in the uses made of equipment on the farms the lack of any central trend in total consumption is not surprising.

Lighting Farm Buildings

In addition to the operator's dwelling, most farms had a general-purpose barn and a poultry-laying house (Table 18). It was not the usual practice to connect the service buildings for electricity, however. Only 18 percent of the general barns and 10 percent of the laying houses were wired for electricity.

Only 55 percent of dwellings other than the operator's were wired for electric service. Most of the other dwellings were those of croppers or laborers.

In addition to the operator's dwelling, other buildings usually wired were dairy barns, broiler houses, and wash houses. Three percent of the farms had dairy barns, but 64 percent of these barns were wired for electric service. Nine percent reported broiler houses, with 71 percent of them connected for electric service. As wash houses usually housed electric washing machines, nearly all of them were wired.

Only occasionally were implement sheds, cribs, smokehouses, garages, and other service buildings wired. Most farmers felt that wiring of these buildings was unnecessary, as about the only use for electricity in them would be for lighting.

Thirty-seven farms had yard lights for service areas.

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[10] The regression equation of 1949 consumption on 1949 income among farms electrified before 1943 was $Yc = 1334 + .135 X$ with a coefficient of correlation, $r = + .24$. The calculated kilowatt-hours is indicated by Yc, the 1949 incomes by X. There were 139 farms in this computation: 4 extreme cases were omitted.

Table 18. Farms with various types of buildings and percent of buildings wired, by 1949 income groups and types of buildings, 1949.

Type of buildings	Income group[1]												All farms			
	Low				Medium				High							
	Farms with bldgs.	Buildings			Farms with bldgs.	Buildings			Farms with bldgs.	Buildings			Farms with bldgs.	Buildings		
		Total	Wired			Total	Wired			Total	Wired			Total	Wired	
			Total	Percent			Total	Percent			Total	Percent			Total	Percent
	Number				Number				Number				Number			
Dwellings:																
Operator	150	150	150	100	248	248	248	100	102	102	102	100	500	500	500	100
Other	10	15	8	53	51	116	48	41	64	158	104	66	251	289	160	55
General barn	132	134	9	7	227	231	39	17	95	109	38	35	454	474	86	18
Dairy barn	3	3	—	—	4	4	3	75	7	7	6	86	14	14	9	64
Wash house	3	3	3	100	7	7	6	86	4	4	4	100	14	14	13	93
Hog house	1	1	—	—	4	6	—	—	1	1	—	0	6	8	—	—
Shop	4	4	1	25	15	15	5	33	13	13	5	39	32	32	11	34
Laying house	120	121	5	4	215	220	26	16	88	105	14	13	423	446	45	10
Broiler house	10	10	8	80	21	22	18	82	16	17	9	53	47	49	35	71
Implement shed	17	17	2	12	44	45	4	9	33	37	3	81	94	99	9	9
Crib	23	24	—	—	37	37	2	5	23	26	—	0	83	87	2	2
Garage	34	35	4	11	80	80	11	14	49	49	6	12	163	164	21	13
Smoke house	11	11	—	—	20	20	4	20	9	9	5	56	40	40	9	22
Pump house	4	4	4	100	13	13	12	92	7	7	7	100	24	24	23	96
Feed storage	2	2	—	—	4	4	—	—	4	4	—	0	10	10	—	—
Potato house	3	3	1	33	—	—	—	—	—	—	—	—	3	3	1	33

[1] Low income, under $2,000; medium, $2,000 to $3,999: high, $4,000 or more.

Electricity Pumps Water

Running water is one of the most valued services made available by central-station electric service. Even so, in July 1950, only 36 percent of the farms in the survey had water systems (Table 19). And only 55 percent of the farms with running water had bathrooms.

About twice as many farms in the southern counties as in the northern had water systems. Reasons for this difference are not clear.

There were more owner-operated farms and more part-time farms in the southern counties but these do not account for such a wide difference. Possibly there has been more educational or promotional effort in the southern counties to encourage the installation of water systems.

Practically all of the farms with running water had it piped into the dwelling. An occasional farm, however, had water piped into a service building or had it piped just outside the dwelling, but not into the dwelling.

The most common method of obtaining water for household use in this area was still the rope and bucket. Almost half of all the farms in this study used this method, (Table 20). Ponds, streams and springs were used by more than half of the farms to provide water for livestock.

Running water in the home is much desired by farmers in this area. It is evident that many more pressure systems will be installed as rapidly as funds and supplies of materials permit.

Table 19. Farms with running water and bathrooms, July, 1950.

Item	Farms represented	Farms with Running water		Farms with Bathroom	
	Number	Number	Percent	Number	Percent
All farms	500	179	36	98	20
Sub-area:					
North	144	33	23	17	12
Central	129	37	29	18	14
South	227	109	48	63	28
Period of electrification:					
Before 1943	143	82	57	46	32
1943 to 1945	112	39	35	28	25
1946 and after	245	58	24	24	10
Tenure:					
Owner	441	179	41	98	22
Cash renter	20	—	—	—	—
Share renter	39	—	—	—	—
Total income:					
Below $2,000	150	40	27	13	9
$2,000 to $3,999	248	74	30	38	15
$4,000 and above	102	65	64	47	46
System of farming:					
Cotton	207	60	29	28	13
Dairy	34	14	41	7	21
Livestock	34	17	50	15	44
General	41	23	56	9	22
Poultry	99	3	33	1	11
Part-time	124	52	42	36	29
Subsistence	51	10	20	2	4
Size of farm:					
Under 30 acres	95	34	36	19	20
30 to 69 acres	147	34	23	23	16
70 to 139 acres	147	54	37	24	16
140 to 259 acres	74	36	49	21	28
260 acres or more	37	21	57	11	30

Table 20. Miscellaneous water supply on electrified farms, by sub-areas, July, 1950.

Items	Sub-area North	Sub-area Central	Sub-area South	All farms
			Number	
Farms represented	144	129	227	500
			Percent	
Farms with:				
Rope and bucket	53	61	40	49
Hand pump	30	8	7	14
Spring, artesian well, etc.	5	6	5	6
Pond, stream or other source for livestock only	53	62	43	51

Alternative Sources of Energy

Household operations: For some uses in the household, lighting and ironing for example, electric energy from central-station sources had little competition from any other source. But for some other uses, cooling and water heating for example, electricity has had strong competition. From the standpoint of total consumption of electricity, these uses are important. There were 110 electric ranges and 30 electric water heaters reported on the 500 farms. These pieces of equipment probably used a fifth of all the electricity consumed by the farms in 1949. Also reported on these farms were 104 gas ranges and 20 gas water heaters. Had these 124 pieces of equipment been electrical instead, the average consumption per farm would have been 20 to 25 percent higher than it was.

Wood was the principal competitor in providing heat for the kitchen range. More than half of all kitchen ranges reported were wood burning. Less than 10 percent burned kerosene. But ranges burning liquified-petroleum gas were being rapidly installed. Almost as many gas burning ranges as electric ranges were reported (Table 21). Of the 104 ranges, 81 were installed after the farms were electrified.

Electric ranges were a little more prevalent in the northern counties than in the southern. But gas ranges were decidedly more common in the southern counties than in the northern. Thirty-six percent of the farms in the southern counties had gas ranges, 15 percent in the central, and only 3 percent in the northern. Gas-burning water heaters were more numerous in the southern counties than in the northern.

This difference between the subareas in the relative use of gas and electrical appliances is no doubt due mostly to differences in rate structures. As mentioned earlier, rates charged for electricity were much lower in the northern counties. Probably, however, a greater effort to sell gas equipment in the southern counties was also a factor.

Practically all of the electric and gas ranges replaced wood-burning ranges.

Table 21. Farms with electric and gas kitchen ranges and water heaters, electrified farms, July, 1950.

Items	Farms represented	Range		Water heater[1]	
		Electric	Gas	Electric	Gas
	Number	Percent	Percent	Percent	Percent
All farms	500	22	21	7	4
Sub-area:					
North	144	26	3	9	1
Central	129	20	15	5	3
South	227	20	36	7	7
Date of connection:					
Before 1943	143	29	30	13	8
1943 to 1945	112	18	22	5	4
1946 and after	245	19	15	5	2
Income:					
Under $2,000	150	15	14	2	3
$2,000 to $3,999	248	18	21	6	4
$4,000 and over	102	39	30	18	5
Tenure:					
Owner	441	25	23	8	4
Cash renter	20	10	14	—	—
Share renter	39	—	—	—	—
System:					
Cotton	207	19	13	6	1
Dairy	34	26	18	18	—
Livestock	34	35	35	18	6
General	41	24	22	10	5
Poultry	9	—	44	—	11
Part-time	124	23	35	6	10
Subsistence	51	16	8	2	—
Size of farm:					
Under 30 acres	95	23	23	5	4
30 to 69 acres	147	19	20	6	4
70 to 139 acres	147	17	20	5	3
140 to 259 acres	74	29	19	15	4
260 acres and over	37	32	24	16	8

[1] Piped in line only.

Occasionally an oil stove was replaced. Two farmers replaced gas ranges with electric and one replaced an electric range with gas.

If a water system is to be fully effective, an automatic water heater is necessary. But of the 180 farms with water systems, only 37 had electric water heaters. Twenty more had gas heaters, 19 had kerosene-burning ones, and one had a coal heater.

Almost 60 percent of the electric ranges and water heaters, half of the gas ranges, and a third of the gas water heaters were installed between January 1948 and July 1950. This indicates a growing demand for such equipment which is not likely to abate in the near future.

For refrigeration purposes, electricity had little competition. Of 556 refrigerators reported, 484 were electric. The others were 64 ice, five gas, and three kerosene, all installed before the individual homes had electric service. These non-electric refrigerators were being rapidly replaced by electric refrigerators on farms of all income levels.

Farm operations: Except among the larger dairy farms, most milking in this area is done by hand. Only ten of the 500 farms in the study used milking machines and nine of these were with herds of 15 or more cows (Table 22). The same ten farms had electric milk coolers and eight of them had dairy water heaters. One farm had a wood-burning water heater in the milk house. No other competing dairy equipment was used.

Most farmers in the area use hens for brooding chicks, since poultry flocks were usually relatively small. Of the 500 farms in the study, 382 raised some chicks in 1950. Forty-two of these used electric brooders, 13 used kerosene, two gas, and one burned wood for heat, (Table 23). Practically all of the electric brooders were on those farms raising less than 400 chicks.

Cost of electricity: Farmers in this study paid an average of $47 for the electricity they used in 1949. This was 56 percent more than the average of 1940 but the kilowatt-hours used were 164 percent greater. As total consumption increased more rapidly than total expense, the cost per kilowatt-hour declined from 5.3 cents in 1940 to 3.1 cents in 1949.

Most of the difference in cost per kilowatt-hour over the years was due to the rate structures under which the electricity was sold. These provided for a declining cost per kilowatt-hour with increased use of electricity per month above an established minimum. This is the "promotional" type of rate schedule. It is intended to encourage greater use of electricity on farms.

Table 22. Farms with specialized dairy equipment, by numbers of cows milked, July, 1950.

Number of cows	Farms represented	Cream Separator		Milking machine, electric	Milk cooler, electric	Water heater, electric
		Electric	Hand			
	Number					
None	64	—	—	—	—	—
1 to 3	278	—	2	—	—	—
4 to 6	95	—	2	—	—	—
7 to 9	30	—	—	—	—	—
10 to 14	21	1	—	1	1	1
15 to 40	12	—	—	9	9	7
All farms	500	1	4	10	10	8

Table 23. Farms with electric and non-electric chick brooders, by number of chicks raised, 1950.

Chicks raised, 1950	Farms represented	Chick brooders	
		Electric	Non-electric[1]
	Number		
None	118	—	—
Under 100	255	18	3
100 to 199	104	18	8
200 to 399	14	5	1
400 to 599	1	—	1
600 to 4,200	5	1	3
Over 4,200	3	—	3
All farms	500	42	19

[1] 13 kerosene, 2 gas and 1 wood.

Table 24. Average consumption and cost of electricity per farm and per kwh, 1940-49.

Year	Farms represented	Average per farm: Consumption	Average per farm: Cost	Cost per kwh
	Number	Kwh	Dollars	Cents
1940	14	565	30.10	5.3
1941	47	452	27.69	6.1
1942	75	543	28.85	5.3
1943	91	675	31.26	4.6
1944	103	728	32.57	4.5
1945	182	710	31.78	4.5
1946	231	855	34.68	4.1
1947	278	961	37.38	3.9
1948	352	1,268	43.20	3.4
1949	500	1,494	46.96	3.1

Typical residential rate schedules for monthly billings in northern and southern counties are shown below. One or the other of these schedules, with slight modification, was used in the central counties.

NORTHERN COUNTIES

First 50 kilowatt-hour—3 cents per kilowatt-hour.

Next 150 kilowatt-hours—2 cents per kilowatt-hour.

Next 200 kilowatt-hours—1 cent per kilowatt-hour.

Next 1,000 kilowatt-hours—4 mills per kilowatt-hour.

All over 1,400 kilowatt-hours—7.5 mills per kilowatt-hour.

(The minimum monthly bill is $1 of which 75 cents is energy charge, 25 kilowatt-hours at 3 cents per kilowatt-hour, and 25 cents is the amortization charge, 25 kilowatt-hours at one cent per kilowatt-hour. The maximum amortization charge is $1 per month.)

SOUTHERN COUNTIES

First 20 kilowatt-hours—$1.95 (minimum bill).

Next 20 kilowatt-hours—6 cents per kilowatt-hour.

Next 40 kilowatt-hours—4 cents per kilowatt-hour.

Next 120 kilowatt-hours—2.5 cents per kilowatt-hour.

All over 200 kilowatt-hours—1.5 cents per kilowatt-hour.

The expense for electricity, a little less than $4 per month per farm, does not appear great. But it amounted to 1.4 percent of the average total income of the farmers.

Farms with low incomes used less electricity than those with high incomes, 869 kilowatt-hours compared with 2,918 in 1949. Their expenses for the year also were less, $34.38 to $74.45 (Table 16). These expenses, however, bore more heavily on the incomes of farmers in the low-income group than those in the high. To pay for the electricity used required 2.4 percent of the total incomes of the low-income farmers as compared to 1.0 percent for the high-income farms. The low-income farmers paid four cents per kilowatt-hour for the electricity they used in 1949; the high-income farmers paid 2.55 cents.

The cash cost of wiring varied widely among the farms. A few farmers did all or most of the work themselves. They bought some supplies and their outlay of cash was as low as $12 to $20. Other farmers wired several buildings and hired all the work done. Some of them paid $300 to $400 to have the buildings wired. The cost of wiring a 4-room house was frequently about $50.

Comments of farmers: During interviews, farmers were asked for their opinions as to the value of electric service to the farm. Definite replies were obtained from 289 farmers. Three said that the cost of electricity was too high. The other 286 indicated a high regard for electricity. Ninety-seven owner-operators said that they could not (or would not) live on a farm without electricity. Nineteen tenants said they would not live on a place without electricity and four more said they would pay more rent for a farm with electric service than for one without. Eight farmers said they could not get satisfactory tenants without providing electric service to the houses.

Some farmers attempted to assign a dollar value to electric service. For example, "It adds $25 an acre to my place in market value." Most replies, however, were general in nature. More or less typical are the following statements. "Greatest time saver a farmer can have." "Best thing that ever came to the country." "Cheapest labor a farmer can get." "Added more to farm life than any other one thing, but the farmer cannot afford all the appliances needed."

Use of Electricity by Rural Residences

Rural residences have been defined as units of less than three acres of land with the value of agricultural production in 1949 amounting to less than $250. (See page 10). Sixty-two of these residences were included in this study, 34 in southern counties, 25 in northern counties, and three in the central area.

Working members of rural residential families are usually employed in towns. For that reason, these units are usually located near an urban area. The numerical importance of them in different counties of the study area depended mainly upon the extent of industrialization and related business activity in the locality.

Rural residences used an average of 1,512 kilowatt-hours of electrical energy in 1949. This was slightly more than the average of 1,494 kilowatt-hours used by farm units.

Characteristics of Rural Residences

Rural residences averaged about 1½ acres of land. Ordinarily, each had a milk cow, and a garden, (Table 25). As a rule that was the extent of their agricultural activity.

Total income for these units averaged $2,445 in 1949, which was less than that for farm units. However, 94 percent of that total was from nonfarm sources and so largely represented net disposable income. Hence, the amount available for family living was probably slightly greater for rural residences than for most farms. About half of the rural residences had total incomes of $2,000 to $4,000 annually, and only 13 percent earned $4,000 or more. None had a total income of as much as $10,000.

Distribution of units by period of electrification followed about the same pattern as for farms. Most were recently electrified, and about 50 percent reported that connection for electric service was made from January 1, 1946, to January 1, 1949.

Two-thirds of all rural residences were owned by the families living in them, and 97 percent of these units had only one dwelling. The dwellings averaged about five rooms each.

Electrical Equipment

Electrical equipment of nearly all kinds was less numerous on rural residential units than on farm units. For example, radios were reported in 87 percent of the rural residences, and on 92 percent of the farms; refrigerators, in 77 percent of the rural residences and on 87 percent of the farms; and

Table 25. Characteristics of electrified rural residences, 1949.

Characteristic	Unit	Amount
Residences reporting	Number	62
Electricity consumed	Kwh	1,512
Cost of electricity:	Dollar	44.86
Total per kilowatt-hour	Cent	3.0
Acreage operated	Acre	1.3
Livestock kept	Animal unit	0.3
Income:		
Farm sales	Dollar	23
Products used in home	do.	123
Off-farm	do.	2,299
Total income	do.	2,445
Date of electrification:		
Before 1943	Percent	29
1943 to 1945	do.	21
1946 and after	do.	50
Tenure:		
Owner	do.	66
Renter	do.	34
Age of operator:		
Less than 30 years	do.	13
30 to 39	do.	39
40 to 49	do.	21
60 and over	do.	27
Total income:		
Less than $1,000	do.	16
$1,000 to $1,999	do.	21
$2,000 to $2,999	do.	39
$3,000 to $3,999	do.	11
$4,000 and over	do.	13

Table 26. Selected household equipment in 62 rural residences, July, 1950.

Equipment	Items of equipment reported
Kitchen range:	Number
Electric	18
Gas	10
Other	34
Refrigerator:	
Electric	49
Ice	8
Other	0
Water heater (piped in line):	
Electric	6
Gas	2
Other	3
Water system (running water in home)	28
Bathroom	18

washing machines, in 39 percent of the residences and on 57 percent of the farms.

The only important electrical appliance that was significantly more numerous in rural residences than on farms was an electric range. Twenty-nine percent of the residences had electric ranges, as compared to 21 percent of the farms. Electric kitchen ranges outnumbered gas ranges almost two to one in these residences. But in more than half of them wood, oil, or some other fuel was still used for cooking. (Table 26).

OUTLOOK FOR FUTURE USE

The average consumption of electricity, as has been indicated previously (Footnote 3), increased at an average rate of 101 kilowatt-hours per farm per year. If this trend continues for another 10 years or so, average consumption per farm will then approach 2,400 kilowatt-hours per year. But forecasts of future consumption of electricity in the Clay Hills area must give consideration to (1) the likelihood of connecting additional farms and homes to the distribution system, (2) characteristics of the farms and homes to be connected, (3) changes in economic conditions and shifts in farming practices, and (4) equipment that may be in use at that time.

As a basis for making estimates of changes that may occur in the next decade, it is assumed that farm income will remain at a relatively high level, that industry will continue to expand in the area and thus offer more opportunities for off-farm employment, that electric distribution systems will be extended until practically all farms in the area have service, and that electrical equipment desired by farmers will be in ample supply. These are assumptions and not predictions.

The year 1960 is taken as a focal point for the estimates. This is not an exact time, but is used merely to indicate the changes that may take place in the coming decade.

Rural service lines are being rapidly extended in the Clay Hills Area. It is assumed that by 1960 the number of farms served in this area will reach 47,500 compared with about 26,000 on January 1, 1949.[11] These farms, it is assumed, will have about 60,000 wired dwellings, about 126 per 100 farms. Apparently most of the dairy and livestock farms of the area have been served. Consequently, most of the farms to be connected are small cotton farms. As a group, they are not likely to purchase as much electrical equipment as those that are now served.

The apparent desire of farm people for water systems, modern kitchen ranges, and all other kinds of equipment to relieve the drudgery of household tasks has been noted in this report. And the limited extent to which electrical equipment is used in farming operations has been pointed out. It is the opinion of the authors that there is a tremendous unsatisfied demand by farmers of the area for equipment of various kinds. The extent to which the demand is satisfied will depend on many things, including educational programs to acquaint the people with the potentialities of electricity and electrical equipment.

It is estimated that farms with water systems will increase from 36 percent in 1949 to 50 percent within a decade and that half of these will have automatic electric water heaters. If this occurs, the consumption of electricity per farm for water systems alone will increase about 450 kilowatt-hours per year and will require the installation of about 14,400 new water systems.

Almost two-thirds of all the electric kitchen ranges reported by the farmers in this study were installed in the 30 months, January 1948 to July 1950. Farms with electric ranges may increase to 27 percent, requiring 7,100 new installations. If this comes about, the average annual consumption per farm for all farms will increase about 160 kilowatt-hours.

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[11] Farm as defined in this study rather than by the definition used by the Bureau of the Census. (See page 10).

All electric ranges, water heaters, food freezers and air conditioners are expected to use about 1,100 kilowatt-hours per farm 10 years hence, (Table 27). This is more than double the average of 1949. Other household equipment doubtless will increase in numbers and in kilowatt-hours consumed, but proportionally not as rapidly as for the above items.

Equipment for use in farm production operations is expected to use 2½ times as much electricity by 1960 as in 1949. However, in volume, this is small. In fact, the electricity used in farming operations is expected to be only about six percent of the total by the end of the decade. However, this is a larger proportion than was used for farming operations in 1949.

Table 27. Estimated average annual consumption of electricity per farm by major uses, 1949 and 1960.

Major use	1949	1960
	Kilowatt-hours	
Dwelling lighting	308	350
Household equipment:		
"Heavy" appliances [1]	481	1,080
"Light" appliances [2]	574	710
Water pumping	65	90
Total for household operations	1,428	2,230
Service building lighting	11	15
Farm operations equipment	48	120
Water pumping	7	15
Total for farm operations	66	150
	1,494	2,380

[1] Ranges, water heaters (piped in line), food freezers and air conditioners.
[2] All other household equipment.

On the basis of equipment expected to be in use by 1960, it is estimated that the average consumption per farm will reach about 2,300 to 2,400 kilowatt-hours annually at that time, or 58 percent more than the average for 1949.

Because of the increase in the number of farms with central-station electrict service and the increased average use per farm, the total consumption by all farms in the area is expected to be about 113 million kilowatt-hours (Table 28). This would be almost three times the 38 million kilowatt-hours used in 1949. Changes in rate schedules during the period cannot be anticipated. But it seems likely that the total amount paid for that electricity by farms would be about $3,000,000 up $1,800,000 from 1949.

Rural residences may not keep pace with farms in increasing average consumption of electricity. However, they are expected to double in number, increasing from 1,300 in 1949 to 2,600 in 1960. Their average consumption may increase to 2,250 kilowatt-hours annually for a total consumption by then of almost 6,000,000 kilowatt-hours.

Table 28. Consumption and cost of electric energy, Clay Hills Area, 1949 and estimates for 1960.

Item	Unit	1940	1949	1960 (estimated)
Electrified farms in area	Number	5,007	26,000	47,500
Average consumption	Kwh	565	1,494	2,380
Total consumption	Kwh	2,828,955	38,844,000	113,050,000
Cost per kilowatt-hour	Cent	5.33	3.14	**
Total cost of electricity used by farms	Thousand dollar	150	1,221	**
Rural residences in area	Number	*	1,300	2,600
Average consumption	Kwh	*	1,512	2,250
Total consumption	Kwh	*	1,965,600	5,850,000
Cost per kilowatt-hour	Cent	*	2.97	**
Total cost of electricity used by rural residences	Thousand dollar	*	58	**
Total consumption—farms and rural residence	Kwh	xxxx	40,809,600	118,900,000

*Data not available.

**No estimates made.

SUMMARY

This is one of a series of similar studies that have been made in the major type-of-farming areas of the country. Basically, the studies deal with factors affecting the consumption of electric energy on farms and with the place of electricity in the whole scheme of farm mechanization.

The study area is the Clay Hills type-of-farming area comprising 19 counties. This has long been an area of small farms. Cotton has been the principal source of farm income. In recent years farmers have been shifting to a more diversified agriculture. At the same time industry has been growing in the area, providing opportunities for off-farm income. Both of these trends are expected to continue for some time.

For this study, records were obtained from 500 farms and 62 rural residences selected at random in each of the 19 counties of the area. They were intended to be representative of all farms and rural residences in the area that had central-station electric service on January 1, 1949. The records were taken in July 1950.

All of the electricity metered on one farm was considered as used by that farm. Most farms had only one dwelling but a few had two or more dwellings and some had service buildings wired.

Among the factors that determine the volume of electricity used on farms in the area are length of time the farm has had electric service, size of specific farm enterprises, particularly dairy, disposable income of the family, tenure of operator, rates charged for electricity, educational programs, and competition from liquified petroleum gas. Some important differences among farmers in the volume of electricity used cannot be accounted for by available data. Some farmers used much more electricity than others with similar electrical equipment, comparable farms, and similar family composition. Some seem to use their electrical equipment freely whereas others, possibly with an eye on the electric bill, use their electrical equipment more sparingly.

From 1940 to 1949, the average annual consumption of electricity by farms in this study increased from 565 kilowatt-hours to 1,494. The increase was as the average rate of 101 kilowatt-hours annually. The increase was more rapid in the last half of the decade than in the first half.

Although the use of electricity per farm has increased, the number of farms with electric service has increased even more conspicuously. As a consequence, the total amount of electricity used by farms in the study area rose from about 2.8 million kilowatt-hours in 1940 to 38.8 million in 1949. The amount paid for that electricity rose from about $150,000 in 1940 to around $1,221,000 in 1949. The expense for electricity per farm in 1949 was approximately $47.

Farmers used this electricity in many ways. Lighting, of course, was the most universal use. All of the dwellings occupied by operators and 55 percent of the houses occupied by croppers and laborers were wired. Many of the unwired dwellings were unoccupied. Eighteen percent of the service buildings were wired for electricity. Virtually all of the farms had one or more radios and hand irons. Almost 90 percent of them had a refrigerator. Washing machines using electric power and household fans were numerous. Twenty-seven different kinds of household equipment were reported. Thirty-six percent of the farms had pressure water systems with electric motors.

Equipment for use in farm operations was less numerous. Only 31 percent of the farms had any electrical equipment for use in farming operations. Another 15 percent had lights in one or more service buildings but had no operating equipment in them. The use of electricity in farming operations amounted to about 5 percent of the total used by the 500 farms in the study —about 95 percent was used in household operations.

Farmers in the northern counties of the study area used more electricity per farm than did those in the southern counties. The average consumption was 1,757 and 1,394 kilowatt-hours respectively. There was much less gas equipment in the northern counties than in the southern. Gas ranges were on 3 percent of the farms in the northern counties, but on 36 percent of those in the southern. One percent of the farms in the northern counties had a gas-burning water heater but 7 percent of those in the southern counties had one. Many of these differences may be accounted for by the lower rates charged for electricity in the northern counties. However, differences in intensity of educational efforts may also have played a part.

There was a general tendency for size of farm, operator's income, and kilowatt-hours of electricity used to be related. Dairy farms and livestock farms used more electricity than any other system of farming. Farms with owner-operators used about twice as much electricity per farm as did those with tenant-operators. But there was little tendency for farms to be grouped near the "average." Wide variations among farms was the rule rather than the exception.

The percentage of farms with water systems and with bathrooms, too, was about twice as high in the southern counties as in the northern. Available data do not explain this difference. Water systems were being installed rapidly throughout the Clay Hills Area. But the rope and bucket was still the most common way of obtaining water for household use. Streams and ponds were commonly used for watering livestock.

Fifty-nine percent of the chick brooders were electric. They were more numerous on farms raising less than 400 chicks. For larger flocks other sources of heat were preferred.

Rural residences used an average of 1,512 kilowatt-hours in 1949 or about the same amount as farms. Equipment used was also similar except that the residences had no equipment for use in farming operations and had more water systems and water heaters.

Within another ten years, the average consumption per farm in this area is expected to be about 2,400 kilowatt-hours per year. Much of this increase is expected to be due to the installation of more electric ranges, water heaters, food freezers and air conditioners. About 21,500 more farms may be connected by that time so that total consumption by all farms may be about three times the total of 1949.

Appendix Table 1. Electric equipment on farms, by date of electrification, July, 1950.

Equipment	Farms reporting equipment and electrified				Pieces of equipment per 100 farms electrified			
	Before 1943	1943-1945	1946-1949	All farms	Before 1943	1943-1945	1946-1949	All farms
				Number				
Farms represented	143	112	245	500	—	—	—	—
Household equipment:								
				Percent				
Radio	97.2	93.7	87.3	91.6	140.6	110.7	106.1	117.0
Iron	98.6	97.3	94.2	96.2	125.1	108.0	106.9	112.4
Refrigerator	92.3	88.3	83.3	87.0	105.6	97.3	91.4	96.8
Washing machine	60.8	56.2	54.7	56.8	65.7	58.0	58.4	60.4
Vacuum cleaner	9.8	4.4	3.2	5.4	9.8	4.4	3.2	5.4
Clock	21.6	16.1	5.7	12.6	25.1	18.7	5.7	14.2
Range	29.4	17.9	18.8	21.6	30.1	17.9	19.2	22.0
Sewing machine	5.5	1.8	2.4	3.2	5.5	1.8	2.4	3.2
Toaster	13.2	4.4	5.3	7.4	13.2	5.3	5.3	7.6
Percolator	6.2	4.4	3.2	4.4	6.2	4.4	3.2	4.4
Roaster	1.3	—	—	.4	1.3	—	—	.4
Hot plate	29.3	26.8	27.8	28.0	29.3	29.5	28.2	28.8
Waffle iron	4.8	1.8	2.0	2.8	4.8	1.8	2.0	2.8
Space heater	4.8	—	3.2	3.0	7.0	—	4.5	4.2
Water heater	12.6	5.4	5.3	7.4	12.6	5.4	5.3	7.4
Household fan	58.7	44.6	33.9	43.4	72.0	53.6	38.4	51.4
Air conditioner	.7	.9	—	.4	.7	.9	—	.4
Exhaust fan	1.3	3.6	.8	1.6	1.3	4.4	.8	1.8
Window fan	.7	1.8	1.2	1.2	1.7	1.8	1.2	1.2
Razor	.7	—	.4	.4	.7	—	.4	.4
Food mixer	4.1	3.6	2.0	3.0	4.1	3.6	2.0	3.0
Blanket	.7	.9	.4	.6	.7	.9	.4	.6
Heat pad	7.6	3.6	3.7	4.8	9.1	6.2	4.1	6.0
Home freezer	6.2	6.2	3.2	4.8	6.2	6.2	3.2	4.8
Meat grinder	—	—	.4	.2	—	—	.4	.2
Churn	22.3	14.3	13.7	16.4	23.0	15.2	13.7	16.8
Television set	.7	—	—	.2	.7	—	—	.2
Livestock equipment:								
Cream separator	—	—	.4	.2	—	—	.4	.2
Milking machine	5.5	—	.8	2.0	5.5	—	.8	2.0
Milk cooler	5.5	—	.8	2.0	5.5	—	.8	2.0
Dairy water heaters	4.1	—	.8	1.6	4.1	—	.8	1.6
Brooder hover	14.6	4.4	6.9	8.6	15.3	4.4	6.9	8.8
Fence controller	2.0	.9	2.8	2.2	2.0	.9	2.8	2.2
Farm shop equipment:								
Air compressor	.7	—	.4	.4	.7	—	.4	.4
Drill press	.7	.9	.4	.6	.7	.9	.4	.6
Portable drill	1.3	.9	—	.6	1.3	.9	—	.6
Tool grinder	2.8	3.6	2.0	2.6	2.8	3.6	2.0	2.6
Power saw	4.8	2.7	2.0	3.0	5.5	2.7	2.0	3.0
Welder	—	—	.4	.2	—	—	.4	.2
Lathe	.7	—	.4	.4	.7	—	.4	.4
Concrete mixer	—	.9	.4	.4	—	.9	.4	.4
Soldering iron	.7	—	.4	.4	.7	—	.4	.4
Planer	.7	—	—	.2	.7	—	—	.2
Table saw	.7	1.8	—	.6	.7	1.8	—	.6
Sanding machine	.7	—	1.6	1.0	.7	—	1.6	1.0
Equipment:								
Wood saw	2.1	—	1.2	1.2	2.1	—	1.2	1.2

Appendix Table 2. Electrical equipment on farms by size of farm, July, 1950.

Equipment	Farm reporting equipment					Equipment per 100 farms				
	Less than 30	30 to 69	70 to 139	140 to 259	260 or more	Less than 30	30 to 69	70 to 139	140 to 259	260 or more
					Number					
Farms represented	95	147	147	74	37	—	—	—	—	—
					Percent					
Household equipment:										
Radio	89.5	92.5	89.1	95.9	94.6	94.7	101.4	108.8	141.9	218.9
Iron	91.6	98.0	98.6	94.6	94.6	92.6	104.8	107.5	128.4	181.1
Refrigerator	73.7	84.4	92.5	94.6	94.6	74.7	88.4	99.3	112.2	145.9
Washing machine	46.3	57.1	57.8	60.8	70.3	46.3	57.1	60.5	63.5	102.7
Vacuum cleaner	7.4	2.7	6.1	2.7	13.5	7.4	2.7	6.1	2.7	13.5
Clock	14.7	9.5	12.9	12.2	18.9	16.8	10.2	15.6	12.2	21.6
Range	23.2	18.8	17.0	28.8	32.4	23.2	19.4	17.0	28.8	35.1
Sewing machine	3.2	2.0	2.7	4.0	8.1	3.2	2.0	2.7	4.0	8.1
Toaster	5.3	8.8	4.1	10.8	13.5	5.3	8.8	4.8	10.8	13.5
Percolator	4.2	3.4	4.8	6.8	2.7	4.2	3.4	4.8	6.8	2.7
Roaster	—	—	1.4	—	—	—	—	1.4	—	—
Hot plate	16.8	34.7	28.6	28.4	27.0	16.8	34.7	29.2	32.4	27.0
Waffle iron	2.1	2.0	2.0	2.7	10.8	2.1	2.0	2.0	2.7	10.8
Space heater	—	5.4	4.8	1.4	5.4	—	6.8	4.8	2.7	5.4
Water heater	5.1	5.6	4.8	15.1	16.2	5.1	5.6	4.8	15.1	16.2
Household fan	45.3	40.1	36.7	50.0	64.9	52.6	46.2	42.2	64.9	78.4
Air conditioner	—	.7	—	—	2.7	—	.7	—	—	2.7
Exhaust fan	3.2	2.0	.7	1.4	—	3.2	2.0	1.4	1.4	—
Window fan	1.0	1.4	2.0	—	—	1.0	1.4	2.0	—	—
Razor	1.0	—	.7	—	—	1.0	—	.7	—	—
Food mixer	1.0	1.4	3.4	6.8	5.4	1.0	1.4	3.4	6.8	5.4
Blanket	1.0	—	1.7	—	2.7	1.0	—	1.7	—	2.7
Heat pad	2.1	5.4	3.4	6.8	10.8	2.1	8.2	3.4	6.8	16.2
Home freezer	2.1	2.0	3.4	9.4	18.9	2.1	2.0	3.4	9.4	18.9
Meat grinder	—	—	—	—	2.7	—	—	—	—	2.7
Churn	7.4	17.0	16.3	27.0	16.2	7.4	17.7	16.3	27.0	16.2
Television set	—	—	—	1.4	—	—	—	—	1.4	—
Livestock equipment:										
Cream separator	—	—	—	—	2.7	—	—	—	—	2.7
Milking machine	—	—	2.0	4.1	10.8	—	—	2.0	4.1	10.8
Milk cooler	—	—	2.0	4.1	10.8	—	—	2.0	4.1	10.8
Dairy water heater	—	—	2.0	2.7	8.1	—	—	2.0	2.7	8.1
Brooder hover	6.3	8.2	9.5	9.4	10.8	6.3	8.8	9.5	9.4	10.8
Fence controller	1.0	2.7	2.0	1.4	5.4	1.0	2.7	2.0	1.4	5.4
Shop equipment:										
Air compressor	—	—	.7	—	2.7	—	—	.7	—	2.7
Sanding machine	1.0	.7	2.0	—	—	1.0	.7	2.0	—	—
Portable drill	—	—	1.4	1.4	—	—	—	1.4	1.4	—
Tool grinder	—	2.7	2.7	4.1	5.4	—	2.7	2.7	4.1	5.4
Power saw	—	2.7	4.1	2.8	8.1	—	2.7	4.8	2.8	8.1
Drill press	—	.7	.7	1.4	—	—	.7	.7	1.4	—
Welder	—	—	.7	—	—	—	—	.7	—	—
Lathe	—	.7	.7	—	—	—	.7	.7	—	—
Concrete mixer	—	—	1.4	—	—	—	—	1.4	—	—
Soldering iron	—	—	1.4	—	—	—	—	1.4	—	—
Planer	—	.7	—	—	—	—	.7	—	—	—
Table saw	—	.7	1.4	—	—	—	.7	1.4	—	—
Other equipment:										
Wood saw	1.0	—	.7	1.4	8.1	1.0	—	.7	1.4	8.1

Appendix Table 3. Electrical equipment on farms, by system of farming, July 1950.

Equipment	Farms reporting equipment							Equipment per 100-farms						
	Cotton	Dairy	Live-stock	General	Poultry	Part time	Sub-sistence	Cotton	Dairy	Live-stock	General	Poultry	Part time	Sub-sistence
								Number						
Farms represented	207	34	34	41	9	124	51	—	—	—	—	—	—	—
Household equipment:								Percent						
Radio	92.3	97.0	100.0	92.7	88.9	94.4	72.5	129.0	120.6	123.5	134.1	122.2	104.0	78.4
Iron	97.1	97.0	100.0	97.6	100.0	96.0	88.2	125.1	111.7	102.9	124.4	122.2	98.4	90.2
Refrigerator	90.8	97.0	88.2	95.1	88.9	82.2	68.6	105.3	102.9	94.5	119.5	88.9	85.5	70.6
Washing machine	60.9	70.6	58.8	73.2	22.2	52.4	33.3	65.7	73.5	58.8	90.2	22.2	52.4	33.3
Vacuum cleaner	3.4	8.8	14.7	—	—	9.7	—	3.4	8.8	14.7	—	—	9.7	—
Clock	12.5	14.7	14.7	12.2	22.2	21.9	7.8	13.5	20.6	14.7	12.2	22.2	16.1	.7
Range	19.3	26.5	35.3	24.4	—	23.4	15.7	19.8	26.5	35.3	24.4	—	24.2	15.7
Sewing machine	1.9	8.8	5.9	4.9	—	2.4	3.9	1.9	8.8	5.9	4.9	—	2.4	3.9
Toaster	5.3	14.7	14.7	4.9	11.1	7.2	7.8	5.3	14.7	14.7	4.9	11.1	8.1	7.8
Percolator	4.8	5.9	8.8	—	—	4.8	2.0	4.8	5.9	8.8	—	—	4.8	2.0
Roaster	—	2.9	—	2.4	—	—	—	—	2.9	—	2.4	—	—	—
Hot plate	26.6	32.4	26.5	36.6	22.2	27.4	27.4	27.5	32.4	26.5	39.0	22.2	28.2	27.4
Waffle iron	2.4	2.9	—	2.4	—	5.6	—	2.4	2.9	—	2.4	—	5.6	—
Space heater	4.3	2.9	—	4.9	—	.8	3.9	6.8	2.9	—	7.3	—	.8	3.9
Water heater	6.3	17.6	17.6	9.8	—	5.6	2.0	6.3	17.6	17.6	9.8	—	5.6	2.0
House fan	36.7	47.0	64.7	48.8	44.4	53.2	25.5	44.0	52.9	79.4	63.4	55.5	62.1	25.5
Air conditioner	.5	—	—	—	—	.8	—	.5	—	—	—	—	.8	—
Exhaust fan	1.4	—	—	—	—	4.0	—	1.4	—	—	—	—	4.8	—
Window fan	.5	—	—	2.4	—	2.4	2.0	.5	—	—	2.4	—	2.4	2.0
Razor	—	—	—	—	—	1.6	—	—	—	—	—	—	1.6	—
Food mixer	1.9	5.9	8.8	4.9	—	3.2	—	1.9	5.9	8.8	4.9	—	3.2	—
Blanket	1.0	—	—	—	—	.8	—	1.0	—	—	—	—	.8	—
Heat pad	3.9	—	5.9	7.3	22.2	5.6	3.9	5.8	—	5.9	9.8	33.3	5.6	3.9
Home freezer	3.4	11.8	11.8	4.9	—	4.0	3.9	3.4	11.8	11.8	4.9	—	4.0	3.9
Meat grinder	.5	—	—	—	—	—	—	.5	—	—	—	—	—	—
Churn	23.7	8.8	11.8	12.2	—	12.9	9.8	24.6	8.8	11.8	12.2	—	12.9	9.8
Television set	—	—	2.9	—	—	—	—	—	—	2.9	—	—	—	—
Livestock equipment:														
Cream separator	—	2.9	—	—	—	—	—	—	2.9	—	—	—	—	—
Milking machine	—	29.4	—	—	—	—	—	—	29.4	—	—	—	—	—
Milk cooler	—	29.4	—	—	—	—	—	—	29.4	—	—	—	—	—
Dairy water heater	—	23.5	—	—	—	—	—	—	23.5	—	—	—	—	—
Brooder hover	7.7	11.8	20.6	14.6	—	8.1	—	8.2	11.8	20.6	14.6	—	8.1	—
Fence controller	2.4	5.9	—	2.4	—	2.4	—	2.4	5.9	—	2.4	—	2.4	—
Farm shop:														
Air compressor	.5	—	—	—	—	—	2.0	.5	—	—	—	—	—	2.0
Drill press	.5	—	—	2.4	—	.8	—	.5	—	—	2.4	—	.8	—
Portable drill	1.0	—	—	—	—	.8	—	1.0	—	—	2.4	—	.8	—
Tool grinder	2.9	2.9	—	4.9	—	3.2	—	2.9	2.9	—	4.9	—	4.8	—
Power saw	3.4	5.9	—	2.4	—	4.0	—	3.4	8.8	—	2.4	—	2.4	—
Welder	.5	—	—	—	—	—	—	.5	—	—	—	—	.8	—
Lathe	.5	—	—	—	—	.8	—	.5	—	—	—	—	—	—
Concrete mixer	—	—	—	—	—	—	1.6	—	—	—	—	—	—	1.6
Soldering iron	1.0	—	—	—	—	—	—	1.0	—	—	—	—	—	—
Planer	—	—	—	—	—	—	.8	—	—	—	—	—	—	.8
Table saw	—	—	2.9	—	—	1.6	—	—	—	2.9	—	—	1.6	—
Sanding machine	.5	—	—	—	—	2.4	—	.5	—	—	—	—	1.6	—
Other:														
Wood saw	1.0	2.9	—	2.4	—	1.6	—	1.0	2.9	—	2.4	—	1.6	—

Appendix Table 4. Electrical equipment on farms, by 1949 total income groups, July 1950.

Items	Farms reporting equipment and with—			Pieces of equipment per 100 farms with—		
	Low income	Medium income	High income	Low income	Medium income	High income
			Number			
Farms represented	150	248	102	—	—	—
Household appliances:			Percent			
Radio	86.7	93.1	95.1	92.0	105.2	182.4
Iron	94.0	98.0	95.1	95.3	107.7	149.0
Refrigerator	78.7	87.1	99.0	80.0	92.3	132.4
Washing machine	42.0	59.7	71.6	42.0	60.5	87.2
Vacuum cleaner	2.0	3.6	14.7	2.0	3.6	14.7
Clock	7.3	11.3	23.5	7.3	12.1	29.4
Range	15.0	18.4	38.8	15.0	18.4	40.8
Sewing machine	2.7	2.0	6.9	2.7	2.0	6.9
Toaster	6.7	5.6	12.7	6.7	5.6	13.7
Percolator	3.3	3.2	8.8	3.3	3.2	8.8
Roaster	.7	—	1.0	.7	—	1.0
Hot plate	30.0	24.2	34.3	30.0	24.6	37.2
Waffle iron	2.0	2.4	5.0	2.0	2.4	5.0
Space heater	3.3	2.0	5.0	4.0	2.4	8.8
Water heater	2.0	6.0	18.4	2.0	6.0	18.4
Household fan	36.0	41.1	59.8	37.3	48.0	80.4
Air conditioner	—	.4	1.0	—	.4	1.0
Exhaust fan	.7	1.2	3.9	.7	1.2	4.9
Window fan	.7	1.6	1.0	.7	1.6	1.0
Razor	.7	.4	—	.7	.4	—
Food mixer	.7	3.6	4.9	.7	3.6	4.9
Blanket	.7	.4	1.0	.7	.4	1.0
Heat pad	3.3	4.8	6.9	3.3	6.0	9.8
Home freezer	2.7	3.2	11.8	2.7	3.2	11.8
Meat grinder	—	.4	—	—	.4	—
Churn	12.0	16.5	22.5	12.7	16.9	22.5
Television set	—	.4	—	—	.4	—
Livestock equipment:						
Cream separator	.7	—	—	.7	—	—
Milking machine	—	—	9.8	—	—	9.8
Milk cooler	—	—	9.8	—	—	9.8
Dairy water heater	—	—	7.8	—	—	7.8
Brooder hover	4.7	10.9	8.8	4.7	11.3	8.8
Fence controller	2.0	2.4	2.0	2.0	2.4	2.0
Shop equipment:						
Air compressor	.7	—	1.0	.7	—	1.0
Drill press	—	.8	1.0	—	.8	1.0
Portable drill	—	—	2.9	—	—	2.9
Tool grinder	.7	2.0	6.9	.7	2.0	6.9
Power saw	.7	2.0	8.9	.7	2.0	9.8
Welder	—	.4	—	—	.4	—
Lathe	—	.8	—	—	.8	—
Concrete mixer	—	—	2.0	—	—	2.0
Soldering iron	—	.4	1.0	—	.4	1.0
Planer	—	.4	—	—	.4	—
Table saw	—	.8	1.0	—	.8	1.0
Sanding machine	—	1.2	1.0	—	1.2	2.0
Other equipment:						
Wood saw	—	1.2	2.0	—	1.2	2.9

Appendix Table 5. Consumption of electric energy per farm, by 1949 income groups, 1940-1949.

Years	Income group			All farms
	Low	Medium	High	
	Kilowatt-hours			
1940	238	653	595	565
1941	273	458	601	452
1942	346	445	813	543
1943	377	534	1,069	675
1944	490	652	1,015	728
1945	444	653	1,058	710
1946	503	782	1,366	855
1947	581	873	1,540	961
1948	703	1,128	2,267	1,268
1949	869	1,287	2,918	1,494
Farms represented				
	Number			
1940	2	5	7	14
1941	14	17	16	47
1942	19	31	25	75
1943	24	36	31	91
1944	28	41	34	103
1945	49	82	51	182
1946	63	109	59	231
1947	74	135	69	278
1948	101	170	81	352
1949	150	248	102	500

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Timber Products Marketing
In Northeast Mississippi

By
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Southern Forest Experiment Station
AND
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Mississippi Agricultural Experiment Station

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

CONTENTS

Page

The Study Area 3
Method of Study 5
Markets 5
  Lumber Market 7
  Pulpwood Market 11
  Railroad Tie Market 13
  Cooperage Stock Market 14
  Miscellaneous Products 15
The Timber Owner and His Marketing Practices 17
  Stumpage 17
  Processed Products 20
Evaluation of the Marketing System 21
Suggestions for Improvement 22
Literature Cited 24

TIMBER PRODUCTS MARKETING IN NORTHEAST MISSISSIPPI

GEORGE M. JUDSON and GEORGE L. SWITZER[1]

This bulletin reports the results of a study of the timber marketing system in a 17-county area (fig. 1) in northeast Mississippi. The timber markets of this area are strongly influenced by the small size of the individual holdings, the depletion of the stands, and the activity of numerous small processing units. In these three respects the area resembles large parts of the pine-hardwood forest region of the South.

The object of the study was to identify and evaluate those features of the marketing system which, if they could be improved, might lead to better management and use of the forest resource. The survey was made in 1951 through the cooperative effort of the Mississippi Agricultural Experiment Station, and the Southern Forest Experiment Station.

THE STUDY AREA

With around three-fourths of its population living in rural territory, northeast Mississippi has an essentially agricultural economy. Columbus and Tupelo are the only cities with more than 10,000 inhabitants. Outside of the restricted prairie section, a natural grassland intensively farmed since the early days of settlement, the land is heavily forested. The pine-hardwood forests of the uplands, together with the hardwoods along the streams, still occupy 2 1/3 million acres, or about 45 percent of the region's total land area (fig. 2).

The forest land is mostly in small holdings scattered among more than 35,000 individuals, two-thirds of whom are farmers. The timber industry owns less than 16 percent of the forest acreage (1)[2].

Agriculture, the chief source of livelihood in the area, has benefited from diversification in the past twenty years with the introduction of manufacturing plants handling dairy and livestock products. Industrial activity has also been increased by the establishment of factories producing such commodities as clothing and electrical equipment. Forest industry, however, which assumed a position of importance early in the area's development, still contributes heavily. In 1946 some 24 million dollars was received from the sale and manufacture of timber products (1).

Railway and highway facilities are well developed, and many timber-using industries are present. Portable sawmills alone number more than 500 (2). The forests, particularly the pine components, have accordingly been cut heavily. Between 1932 and 1948 (the dates of the two Forest Surveys of the State) the volume of sawlog growing stock dropped 40 percent. Total volume in sawlog growing stock is now 2,176 million board feet, of which two-thirds is in hardwood (4). The hardwoods are prevailingly of poor quality: 60 percent of their volume is in grade 3 logs. In addition, a large proportion of the growing space in most stands is preempted by cull trees. Total growing stock (trees 5 inches or larger in diameter at breast height) was 734 million cubic feet in 1948, also substantially less than in 1932. Because the volume of growing stock is low, the average forested acre grows only 62 board feet of timber annually, or about one--fourth of the land's potential (1). Further, since the best and

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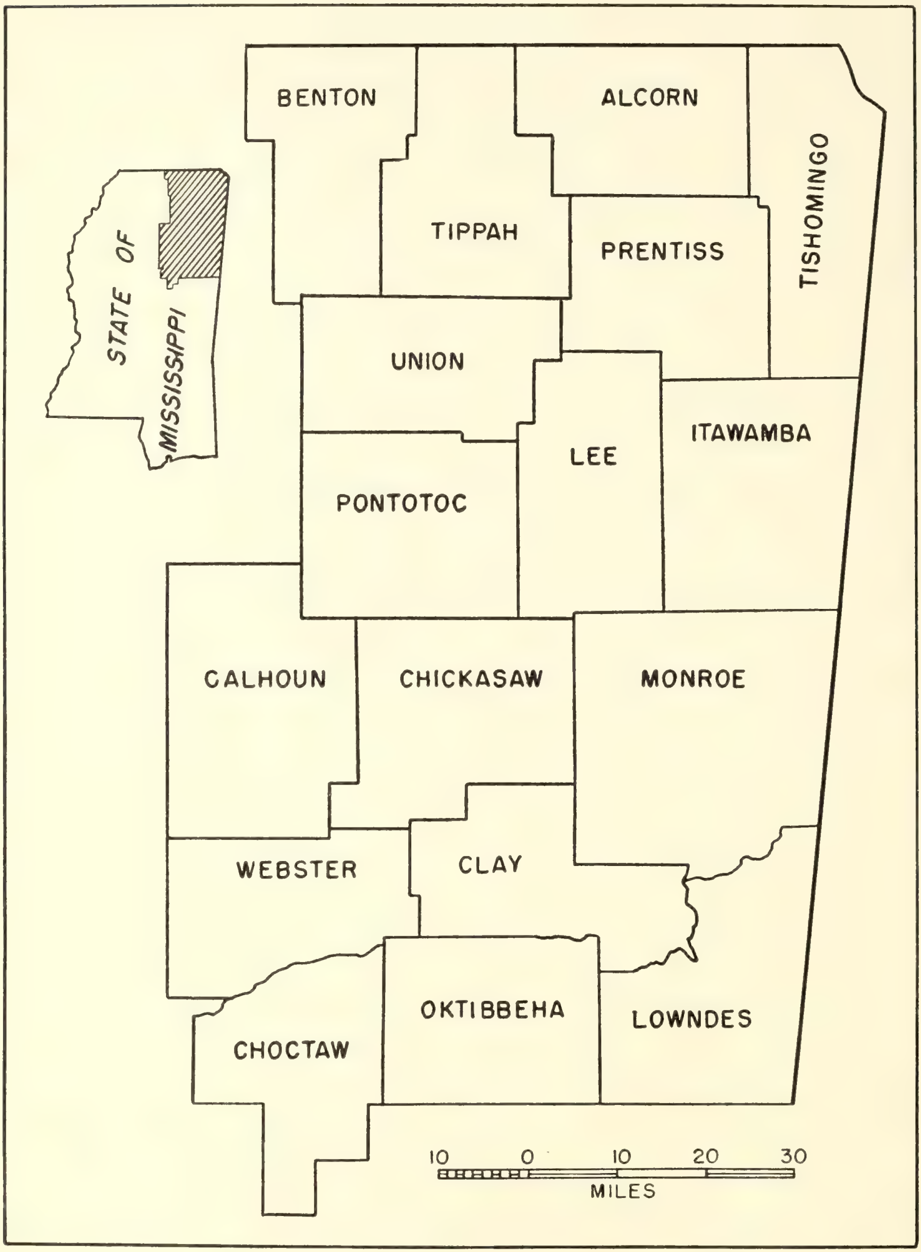
[1] Mr. Judson is a forester at the Southern Forest Experiment Station, which is maintained at New Orleans by the Forest Service, U. S. Department of Agriculture. Mr. Switzer is assistant forester, Mississippi Agricultural Experiment Station. This study was conducted under Title II of the Research and Marketing Act of 1946.

[2] Numbers in parentheses refer to Literature Cited.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CLAY
OKTIBBEHA
LOWNDES
CHOCTAW
10
0
10
20
30
MILES

Figure 1. Location of study area in Northeast Mississippi.

largest trees are usually chosen for cutting, the quality and size of the remaining trees are continually decreasing.

Method of Study

The information in this report was gathered in interviews with over 160 local timber buyers and forest landowners. For sampling purposes, the following five classes of forest landowners were recognized: 1—**small farmers,** holding 100 acres or less of forest land; 2—**large farmers,** holding more than 100 acres; 3—**small non-farmers,** (businessmen, wage earners, and the like) holding 500 acres or less; 4—**large non-farmers,** holding more than 500 acres; 5—**forest industry,** all forest landowners receiving more than one-half their income from timber operations, including processing.

The last class—forest industry—is principally of interest as buyers and processors of timber and is not included in the discussion of forest landowners and their selling practices. Buyers were grouped according to the product they handled or the operation they performed. The sawmills, concentration yards, stave plants, tie dealers, pole and piling dealers, pulpwood contractors, other manufacturers, and other non-processing buyers were included. Sawmills were further classified according to the nature of their operations, that is, farm mills, custom mills, concentration yard suppliers, small and large independents.

Ninety-three landowners furnished detailed information on over 150 sales made during 1937 through 1950. Information was gathered only on those sales which individually amounted to $100 or more. Seventy-two timber buyers and operators provided descriptions of their operations and methods.

Forest landowners to be interviewed were selected at random from lists of owners in the area. The sample of buyers was made from names accumulated in the course of the interview with timber owners and supplemented when necessary from available lists.

The ranges in acreage of forest land held by the classes sampled are as follows: small farmers, from 7 to 100 acres with a median of 50; large farmers, from 105 to 320 acres with a median of 166; small non-farmers, from 20 to 320 acres with a median of 95; and large non-farmers, from 530 to 3,000 acres with a median of 850 acres.

For the period 1937 through 1950, the range and median of the values of individual sales, in dollars received by owner classes, were: small farmer, $100 to $3,500, median $365; large farmer, $100 to $13,000, median $400; small non-farmers, $100 to $5,000, median $600; and large non-farmers, $500 to $14,000, median $1,900.

MARKETS

More than 600 buyers and processors of timber are active in the area. Typically, production is generated through small local operators who undertake some or all of the initial locating, negotiating, logging, processing, and transporting operations that link the timber owners with the market. Because of their ready acceptance of these operations, which are arduous and require a particular combination of experience and temperament, these individuals—sawmill operators, tie buyers, pulpwood producers, and the like—are in a sense the primary producers.

The lumber, pulpwood, tie and cooperage industries provide the principal markets. These industries, together with a few manufacturers or handlers of such other products as dimension and handle stock and poles and veneer logs, utilized 45 percent of the timber produced in 1946 (the latest year for which data are available). The remaining production went into fuel wood, fence posts, and other products used mainly at home (table 1).

Most of the marketed products leave the area. Outside users in the construction lumber trade, flooring and furniture

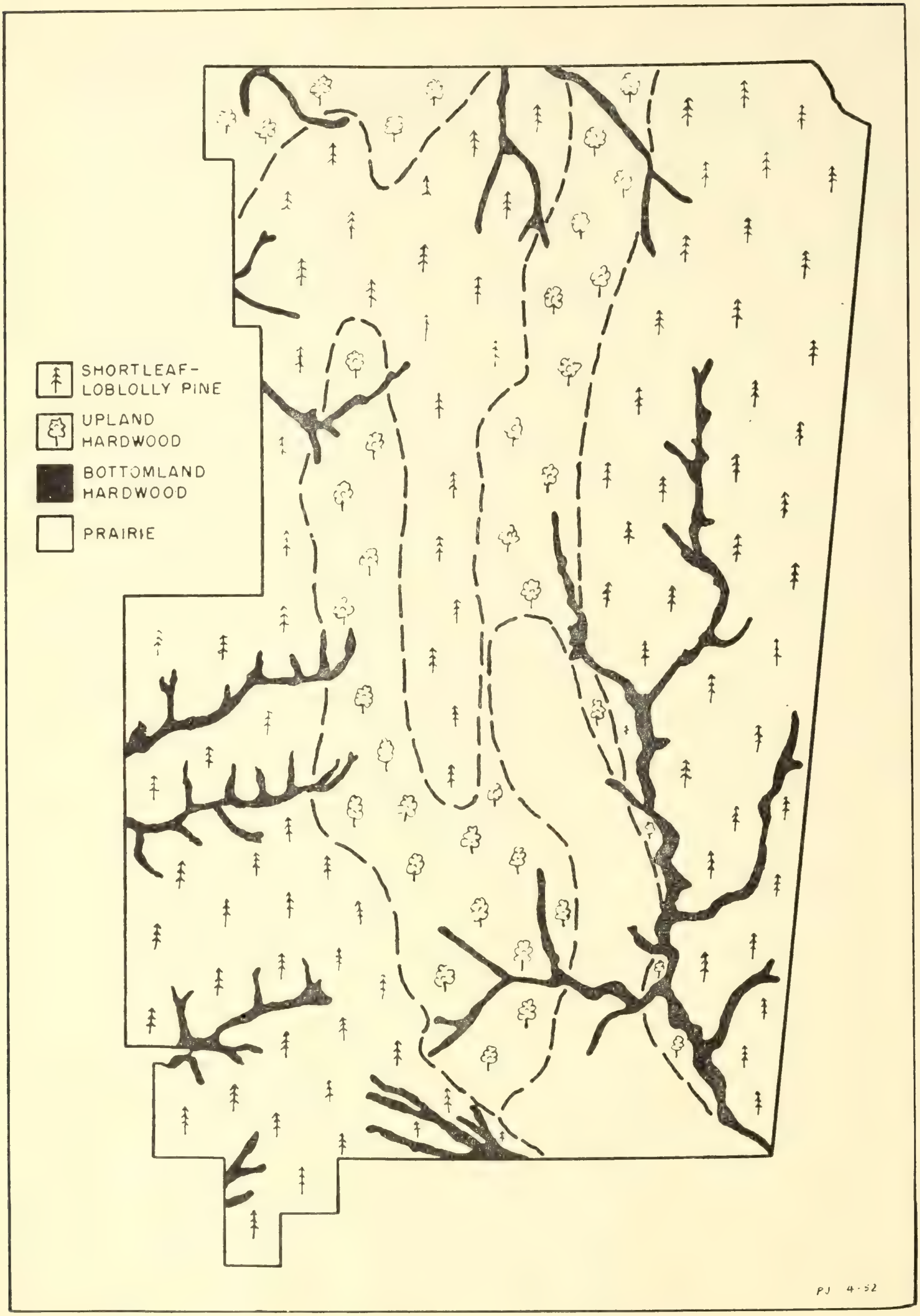
SHORTLEAF-LOBLOLLY PINE
UPLAND HARDWOOD
BOTTOMLAND HARDWOOD
PRAIRIE
PJ 4-52

Figure 2. Forest zones in northeast Mississippi.

industries, paper mills, distilleries, railroads, and veneer plants obtain area materials from local producers and dealers directly, or through wholesalers and brokers. Local consumption is limited principally to bridge timbers, planking, and construction lumber.

Raw materials enters the product markets mainly through stumpage sales, in which the forest landowner or seller is a principal figure. The landowner and his marketing practices are described in a later chapter. The following discussion centers about products markets in which the processors and operators are of primary importance.

Lumber Market

In 1946 lumber comprised over three-tenths of the total volume of all timber cut in the area and nearly 75 percent of the material marketed (table 1). Pine lumber, principally for construction, represented 44 percent of all lumber production and totalled 108 million board feet in 1946 (table 2). The remaining lumber was hardwood of many species, cut either for local construction use or as raw material for future manufacture. The nearness of the hardwood centers at Memphis and Jackson, Tennessee, gives the area a large and ready market for factory-grade hardwood lumber.

Since lumber varies in species, grade, seasoning, degree of manufacture and value, marketing methods vary according to the operations necessary to assemble, prepare, and sort the material for use. The rough unseasoned mill-run lumber produced by the small operator may be sold directly to local users for farm repairs and construction, uses in which requirements are not exacting. To reach national markets, rough lumber usually must be further seasoned, graded, sorted, and sometimes planed. Since the small mill is usually equipped only for rough sawing, the lumber passes from it to concentration yards and large mills that provide the necessary skills, equipment, and finances. From these agencies, it goes through channels leading to the ultimate user, or particularly with hardwood, to furniture and similar industries for further manufacture.

Types of Sawmill Operation

In 1946 there were 566 sawmills operating in the area; their total production was 245 million board feet (table 2). An understanding of the character of these sawmills (figs. 3 and 4) as related to the marketing of lumber in the area is important.

The small sawmills (those having an annual production of less than 3 million board feet) comprise 98 percent of the area's mill population and produce 80 percent of the lumber. As a group, these mills are distinguished by a high degree of portability and a minimum capital investment. Most of them also suffer the ills of technical inefficiencies. Three kinds of small sawmill operations exist.

Farm-machinery mills are used on the farm to fill the same sort of role as the corn mill or silage cutter: home--use lumber is the main product and very little

Table 1. Area production by product and species group in 1946[1].

Product	Softwood	Hardwood	Total
	Thousand cubic feet		
Lumber	8,915	9,401	18,316
Pulpwood	1,939	1,322	3,261
Ties	213	1,446	1,659
Cooperage	--------	866	866
Other marketed products	91	875	966
Domestic use	1,093	29,703	30,796
Total	12,251	43,613	55,864

[1] Source: Forest Survey data on file at Southern Forest Experiment Station.

Figure 3. Small sawmills, of which this is typical, produce 80 percent of the lumber sawed in northeast Mississippi.

lumber is marketed. They have an average annual production of less than 100 thousand board feet. **Custom and neighbor-market mills** manufacture lumber primarily for the neighborhood on a custom or sale basis. They typically have an average annual production of less than 500 thousand board feet. They resemble the farm-machinery mills, in that they produce lumber principally for local use, they operate part-time, and their owners usually have some other means of livelihood, chiefly farming.

The third group of small mills cut the bulk of the lumber that goes to concentration yards. Their average annual production is less than 3 million board feet but usually more than 100 thousand board feet. These **concentration yard suppliers** include both contract and small independent mills. The contract mills are bound by their agreement with the yard and

Table 2. Lumber production in northeast Mississippi by mill production class and species, 1946[1].

Production class (M bd. ft. per year)	Number of mills	Production		
		Softwood	Hardwood	All species
			M bd. ft.	
0— 499	408	37,187	40,364	77,551
500—2,999	149	57,175	61,239	118,414
3,000+	9	14,138	34,875	49,013
Total	566	108,500[2]	136,478	244,978

[1] Source: U. S. Bureau of the Census.

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[2] Of this total, 9,230 M board feet was in sawn ties. Probably tie production is principally by mills having an annual output of less than 3 million board feet and typically less than 500 thousand board feet.

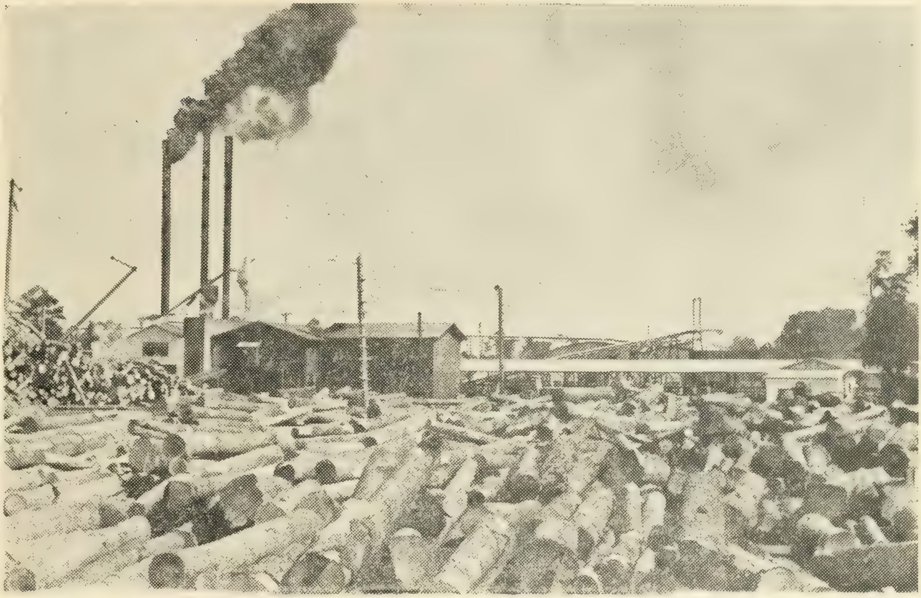

Figure 4. The skills and equipment to handle high grade hardwood timber are most often found at large mills. Such mills therefore saw principally hardwood. They also act as assembly points for the hardwood lumber produced by small mills.

thus have less freedom of action, while the independents have the opportunity to seek out the markets that will be the most remunerative.

The operators of small mills have many of the characteristics of the small timberland owners. They are often farmers operating locally, 75 percent of their purchases being in a single county. Their knowledge and skills in timber matters, while generally more extensive than those of timber owners, are usually not highly developed. Their financing abilities are limited, so that they normally have to ally themselves with larger agencies farther along the marketing chain, which thus limits their freedom of negotiation and degree of specialization.

In contrast to the various groups of small sawmills are the large independents. These mills produce at least 3 million board feet annually and have access to the general market either directly or through commission men and brokers. They are more permanently located and most of them operate full time, grade their lumber, and generally may be considered industrial plants. They comprise less than 2 percent of the sawmills but cut 20 percent of the lumber (table 2).

Softwood and hardwood operations differ considerably. The net value of hardwood is dependent in a large measure upon the skill and experience applied from the moment the ax enters the tree until the product is sold. The harvesting, manufacture, and marketing of softwood are less specialized. Thus, the small part-time mills are under greater handicaps in the hardwood field. The successful hardwood operations are exemplified by the large plant with excellent equipment, diversified outlets, and skilled workers. Seventy percent of the production of the large mills in the area is hardwood lumber (table 2).

The Concentration Yard

The movement of lumber from the small mills to the outside markets is principally through the concentration yards and the large mills in and near the area. These yards and mills serve both as assembling points for the lumber produced locally and as suppliers to the general market.

The pine lumber produced by the small mills in the area enters the outside markets almost entirely through concentration yards. The usual pine concentration yard is composed of a storage yard and sheds, a planing mill for dressing rough lumber, and occasionally dry kilns. The larger yards also have equipment which enables them to produce various types of matched and pattern stock. The ways. While many yards maintain a retail department for selling lumber to local users, they are mainly lumber processors and wholesalers to outside markets.

In the handling of hardwood lumber, the concentration yard-small mill alliance does not achieve prominence. The few hardwood lumber concentration yards in the area are small, being simply storage yards where the lumber is seasoned and sorted. Much of the hardwood output of small mills is low grade material—as timbers and bridge planking—that does not require the services provided by the concentration yard, but can be sold locally. The bulk of the hardwood lumber that leaves the area from the small mills moves through the yards of the largest mills, which add the lumber to their own stocks.

Concentration yards own and operate some mills in the area. However, the added responsibilities in respect to labor and mill maintenance and operation discourage this practice. When the operator, small or large, can finance his own timber purchases, he is free to sell his lumber in any of the markets available, seeking the best deal on each truckload he produces. Since most small mills must seek the help of a yard to finance stumpage purchases, they become tied to that yard until the obligation—usually in the form of a mortgage on the mill—is discharged. When the yard buys stumpage, it generally contracts for logging, sawing, and transporting by the thousand board feet. The contract mill is paid weekly as the lumber is delivered. Many yards buy both lumber and stumpage, relying on the mill operators to handle the smaller purchases of stumpage. There is competition between yards for stumpage, lumber, and the services of the most reliable and efficient sawmill operators.

Most of the yards purchase ungraded lumber and pay a mill-run price. When grades are employed, as they are in a few of the hardwood yards, a usual practice is to recognize the higher grades and place a flat value on, or refuse to accept, the lower grades. This practice leads the mill operators to prefer a run-of-the-mill price. The benefits of grading are not apparent until the lumber moves out of the yard, and competence in grading makes its appearance at this stage.

The General Lumber Market

The concentration yards and the largest mills distribute lumber into the general lumber market. While they attempt to maintain stable connections with their markets, there is always a strong tendency to trade among alternatives in quest of the best deal. Much of the marketing is on a sale-by-sale basis depending on the opportunities, the yard or mill dealing directly with the buyer. In order to broaden their markets, the largest mills and yards also deal through commission men, brokers, and wholesalers in the larger cities and wood-consuming centers. Thus, the movement of products depends to a degree upon the efforts of the mills and yards and their employed marketing agencies to maintain reliability, personal services, and the good will of their customers.

Lumber is shipped largely by rail, but small lots are sent to direct consumers in Indiana and Illinois on trucks that are returning to these areas after a haul into the South (fig. 5). The nearness of the Memphis and Jackson, Tennessee, mark-

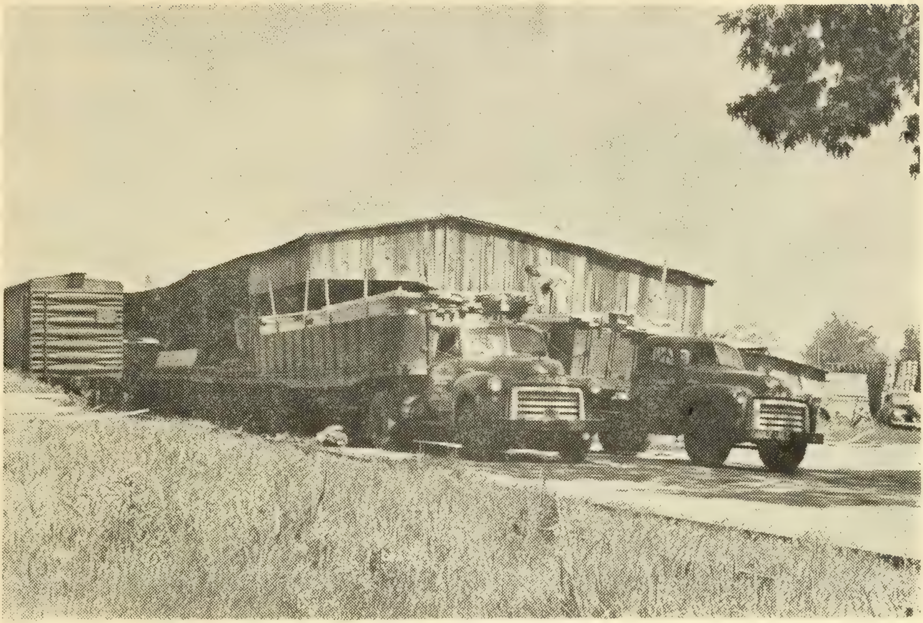

Figure 5. Lumber is shipped to the general market largely by rail, but small lots are sent directly to customers by truck.

ets also encourages shipment by truck.

Pulpwood Market

Northeast Mississippi has no pulp-consuming industries and lies outside the principal procurement zone of pulp mills in adjacent territories. Production in 1946 was about 45,000 standard cords, or 13 percent of the cubic-foot volume of the principal products marketed. Fifty-nine percent of the pulpwood volume was pine. The remainder was hardwood, principally sweetgum (table 1).

At least eight companies have purchased within the area, sending materials to mills in Louisiana, Arkansas, Tennessee, Alabama, and other parts of Mississippi. The most consistent purchases have been made in the southwest and northeast counties. In 1946 the cordage from Choctaw and Tishomingo counties, where rail locations and material supply are favorable, accounted for 62 percent of the total pulpwood production in the area (2).

The pattern of buying activity is shaped by the railroad network, none of the area being within truck haul of pulp mills. At points along the principal railroads, yards are established to receive pulpwood from surrounding woodlands (fig. 6). Most of the timber in the study area can be reached in this manner. Where rail facilities are unfavorable—as in the Fulton locality in Itawamba County—buyers are lacking.

Dealer System

The companies purchasing the bulk of the pulpwood maintain one or more representatives or dealers in the area. These dealers are assigned territories of varying size tributary to the main rail lines. Each dealer, with occasional assistance from company personnel, organizes and supervises procurement within his territory. Dealers are selected on the basis of their capital, knowledge of the timber resource and marketing practice, and character. Generally, they have business interests in addition to pulpwood buying. The dealer's

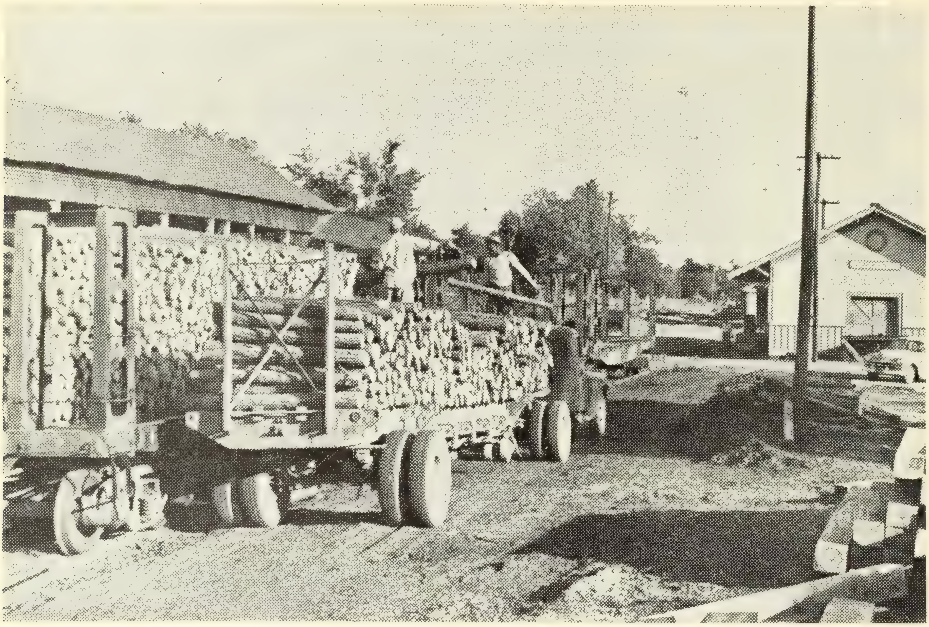

Figure 6. Northeast Mississippi has an expanding pulpwood market, purchases being made at points along the railroads.

relationship with the company is not established in writing, nor is he a salaried employee. The company periodically notifies him as to the volumes it will accept. October and November are typically months of short pulpwood supply because of farm demands for labor, and because the deterioration that occurs in the preceding warm months prevents stockpiling. To stimulate production during this time, the company may determine the dealer's share of its annual requirements on the basis of his deliveries during these two months.

The company's price to the dealer is based on wood loaded on the car at the shipping point, and it is the same at all points within his territory. The price, usually based on the standard cord, remains relatively stable for periods of six months to a year, sometimes longer. There is some tendency for companies to raise prices in the months of short supply. Payment to the dealer is made when the wood is accepted at the plant, the company paying freight costs. When wood is not accepted, the dealer must bear the costs of shipment and disposal.

While the company sets a price which it considers will bring in raw material at the lowest possible cost, many factors of supply enter into the determination of price. Competition from other users of timber, incentive for those engaged in harvesting and marketing, and the advantages of maintaining a well-developed procurement organization in the field are all considered. The price paid for unpeeled hardwood was about 88 percent of that paid for unpeeled pine in the spring of 1951. However, it is usually required that hardwood be peeled, which approximately doubles its price.

The company, to determine the volume delivered by the dealer, measures a sample of the bolts to obtain the average bolt length in inches as well as the average height and length of the stack. The cubic contents are then computed and converted to standard cords. The dealer's margin is the difference between the price he receives for pulpwood loaded on the car at the shipping point and all costs of getting the pulpwood to that stage. Currently the dealers operate on a margin of around 75 cents per cord. Margins are narrowest during the months of short supply when the dealer endeavors to increase shipments in order to obtain larger quotas during the remainder of the year. When a company finds it necessary to build up a reserve of wood, it authorizes the dealers to accumulate stocks at their yards. The company then makes an advanced payment on this banked wood, currently 70 to 90 percent of the total price. When the wood is accepted at the plant the remainder is paid, plus an additional amount in recognition of the fact that all banked wood must be handled twice.

While deliveries to his yard by timber owners fill part of the dealer's needs, he must also reach those timber owners who do not wish to cut and haul wood themselves, or who have other opportunities to sell their timber. Thus a dealer will often bargain directly with an owner for stumpage, hire saw crews, and supply or contract for trucks. When his territory and the volumes are relatively large and his other business interests are demanding, he engages sub-contractors or "producers" to handle these operations. The dealer may finance his producers in any of their activities.

Until recently, the study area generally has been a "stress" area, to be entered only when companies were unable to obtain sufficient wood from their primary procurement centers. This condition has been a greater deterrent to pulpwood production by the individual landowner than has any price consideration. Of late, however, procurement has expanded and a more stable market exists. The price quoted by most pulpwood dealers is based on the 5-foot unit (4 by 5 by 8 feet) rather than on the standard cord. Little variance in price was found throughout the area.

Railroad Tie Market

All ties produced in the area are used by railroads—none go to mines.

Ties made up less than seven percent of the cubic-foot volume of the principal products marketed in the area in 1946 (table 1). The total was some 500,000 pieces (2). Almost 90 percent of the ties are hardwood, principally oak.

Production

The bulk of the area's ties, almost 70 percent of the total production, are produced by small portable sawmills. The remaining production is by tie cutters or hacks working up their own or purchased timber. Tie production is a small-scale operation particularly adapted to the existing stands of scattered and small-sized timber. However, the wide use of preservative treatment, and the long seasoning period required—usually a year or more—limit the small producer to the early stages of tie manufacture. Furthermore, the demand fluctuates violently with business cycles. For these reasons the small producer markets through the well-financed tie companies, though he is not eliminated from direct dealing with the railroads.

Market Agencies

The railroads procure their ties from independent dealers and contractors who produce and assemble ties locally for seasoning; from large companies who buy, produce, treat, and market ties; and by direct purchase from tie cutters and small sawmills. There are no outstanding marketing centers in the area, ties being purchased at nearly all railroad stations. A treating plant is located within the area at Columbus and in nearby Louisville and Grenada, Mississippi.

Large tie companies make a primary business of handling, and usually of treating, ties and timbers for railroad and industrial use (fig. 7). Railroads, by contrast, commonly buy untreated ties and contract separately for their preservative treatment. The tie companies buying in the area operate over extensive territories in Mississippi and adjoining states, and own or are affiliated with treating plants. Each company has a central office, obtains the contracts with the railroads, and then allocates production and preservative treatment to the area of operation that can best fulfill each contract.

In northeast Mississippi tie companies obtain their ties through a network of local agents. The agents are bonded employees and are responsible for contracting for, receiving, grading, paying for, yarding, and loading the ties. Carload lots assembled at loading points are sold to the railroads, who inspect and receive them at these points, or are shipped to treating plants and company-owned yards for preservative treatment, storage, and later sale. A few tie companies own timber tracts in the area and produce as well as market ties.

The independent local dealers, operating entirely on their own capital, sell either to tie companies, agents of the railroads, or both. Their purchases are based upon advance contracts or, when the market is active, upon speculation as to future demand. Some local dealers depend upon their own production, supplemented with purchases of ties, while others place main reliance upon the purchase of finished ties. Some purchase continuously while others buy only when they have contracts or orders. A few of the local dealers widen their source of supply and accumulate larger quantities by engaging sub-contractors and yard buyers along rail lines. This in turn betters their bargaining position in the general market and enables them to compete on more even terms with the larger tie companies in procurement.

Prices paid local dealers follow closely those established by the larger tie companies. Dealers with contracts usually purchase on a margin of 10 to 15 cents per tie, while the others seek a greater margin. Where sub-contractors are employed, the main contractor's margin is usually 5 cents per tie, or approximately the cost of handling. His chief concern is to obtain quantities great enough to meet competition with the tie companies.

Cooperage Stock Market

The market for cooperage stock in the area is restricted to staves and heading for tight cooperage. It is further limited in that the local market is only for bolts, logs, and stumpage; the heading and staves manufactured from this raw material are transported outside the area to the general market. In 1946 cooperage accounted for less than 4 percent of the total cubic-foot volume of the principal products marketed (table 1).

Timber for the manufacture of staves and heading must meet exacting specifications: it must be white oak; it must be sound, devoid of mineral streaks, worm and grub holes, and other defects; and each bolt must have a specified amount of clear heartwood (usually 6 inches) and thus must be of a specific minimum diameter.

Methods of Production

The large tight-cooperage companies are either subsidiaries of or affiliated with the distilling industry, and are the only producers of staves and heading in the area. Most often a company operates a portable mill under the supervision of a company employee. The company buys delivered bolts and logs, individual trees, or entire tracts. It prefers to operate through local bolt producers who acquire the standing trees, cut and manufacture bolts, and deliver them to the mill. The company occasionally finances these producers in the purchase of raw material.

The company may also contract with local operators to produce staves and heading. These operators are advanced money

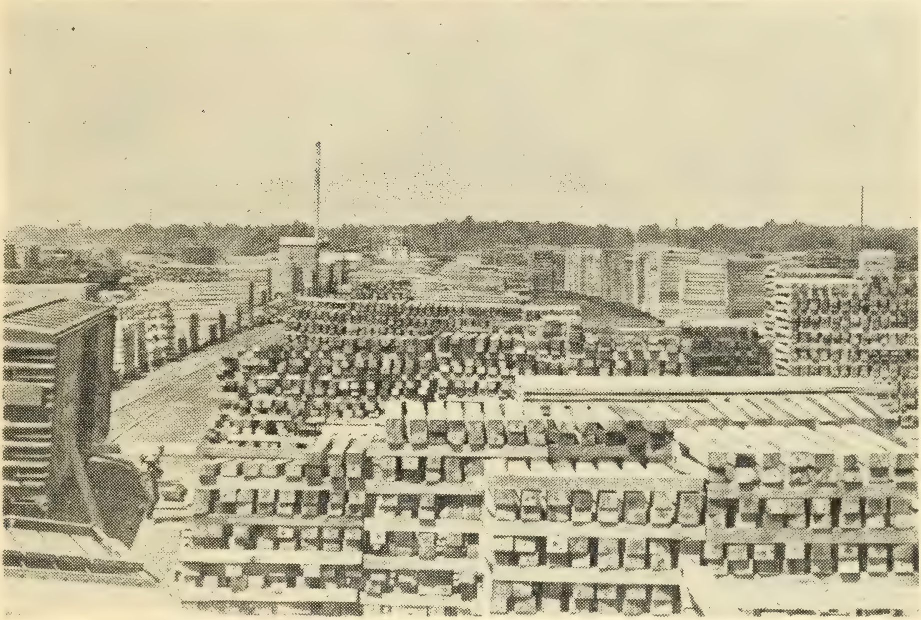

Figure 7. This large company assembles and treats timber and ties for industrial and railroad use. The company's local agents purchase the ties from tie hacks and small sawmills.

on their contracts to enable them to pay for the costs of purchasing and operation. This set-up is the nearest to an independent operation encountered in the area in this market. The mill may be either the operator's or one which the company has rented or loaned to him.

Sometimes a company buys stave and heading bolts at railroad shipping points and transports them to mills or centers of manufacture outside the area. Though this method is not widely used, it is indicative of the keen competetion for and the relative scarcity of raw material.

Miscellaneous Products

The miscellaneous commercial products—logs, handle stock, poles and piling, fence posts—comprised less than 4 percent of the principal products marketed in 1946 (table 1). The only active log buyers in the area are those seeking high grade yellow-poplar, oak, sweetgum and the like. These buyers are directly or indirectly connected with the veneer or hardwood flooring and furniture industries. In woods-run logs, trading is inactive, the landowners preferring stumpage sales. Nevertheless, most sawmills, stave mills, and similar processors will purchase timber in log form. Operators frequently remarked that they would accept quantities as small as one log if delivered.

Veneer mills in Memphis and Jackson, Tennessee, and Louisville, Kentucky, obtain logs from the study area, principally from those large mills which separate out the highest grade logs of veneer species for resale. Such logs are also purchased from professional log dealers, or others who occasionally assemble or deliver smaller lots. From the northern portion of the area truck-load lots are delivered to the Memphis and Jackson markets, but larger amounts are shipped by rail. Veneer log buyers provide grade specifications and price lists upon request. Logs are f.o.b. at either the loading point or buyer's location; in the latter case the seller receives an additional sum approximating shipping costs.

Whether logs are inspected at the loading or the receiving point depends upon the familiarity of the seller with the buyer's specifications, the relationship between buyer and seller, and which party pays for shipment. Payment may be made upon delivery or, for logs purchased at the loading point, and advance payment of 80 to 90 percent of the total price may be made following inspection. The remainder is paid when the logs reach the plant.

In the process of accumulating veneer logs, veneer mills and professional log dealers commonly purchase mixed stumpage. Then, after the veneer logs are separated out, the sawlogs remain to be disposed of. These may be sold outright to sawmills or traded to them for veneer logs. The small amount of high-quality hardwoods held by the typical timber owner limits his direct participation in the high-grade log market.

Among the timber industries in the area are manufacturers of handle and ski blanks, furniture squares, finished tool handles, and chairs. Ash, hickory, white and red oak, and sweetgum are the main species used by this group. These industries purchase raw material as logs or stumpage, and may deal with a hundred or more timber owners in a year. The purchasing area of one of these companies commonly includes 5 to 10 counties.

While small amounts of some of these products are sold within the area, most of the products reach general markets in other parts of the United States and abroad. Shipments of tool handles to England, Australia, and Sweden were reported. Much of the business of these manufacturers is carried on through brokers and manufacturers' agents, and the competition in selling comes principally from manufacturers in neighboring states. The hardwood industry in nearby Memphis provides both outlets and competition for

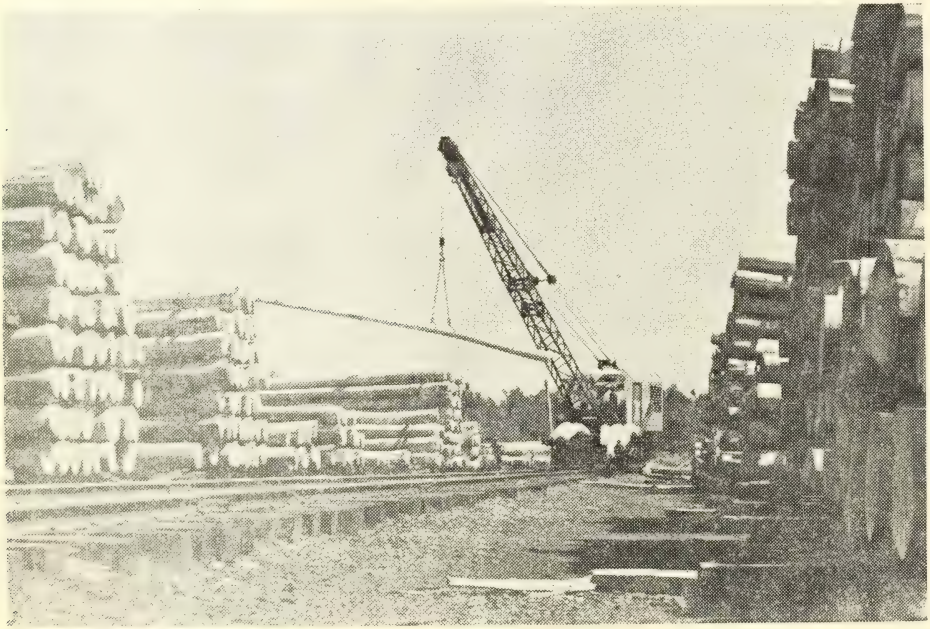

Figure 8. Most of the poles and piling found in the yards of local treating plants are obtained outside the study area.

producers in northeast Mississippi.

Though treating plants for poles and piling are located in and near the study area, they obtain most of their material elsewhere (fig. 8). Much of the area's pine timber is unsuitable for these uses. Such trees as might be suitable are scattered and go to swell the cut of the sawmills.

The market for fuel wood and fence posts is not organized. However, since posts come from as far as Texas, it appears that greater use of the area's timber might be made, particularly as simple methods for the preservative treatment of fence posts have been developed.

Sporadic purchases of low grade hardwood are made by a chemical wood plant in Memphis.

The Timber Owner and His Marketing Practices

The area's timber markets depend almost entirely upon production from the lands of the non-forest industry owners—farmers, wage earners, businessmen, and the like. These owners hold 84 percent of the area's forest land and comprise 99 percent of all the forest landowners. The marketing of timber products, however, occupies only a minor place in their economy. Farmers comprise 67 percent of the forest landowners, but according to the Census of Agriculture, the sale of forest products from area farms in 1944 accounted for less than two percent of the total farm income from all products sold.

The following discussion concerns only those landowners outside of the timber industry. The market most closely associated with and of greatest importance to these owners is stumpage. Stumpage sales comprise 52 percent of those made by farmers and 82 percent of those made by non-farmers (fig. 9). In terms of gross income to the forest owners, stumpage sales bulk even larger. The small farmers obtain 59 percent, large farmers 85 percent, and non-farmers (both small and large) 95 percent of their gross timber income from stumpage sales (fig. 10). These timber owners prefer stumpage sales because they generally lack the equipment and experience, and occasionally the time, to harvest their own timber. There is, however, a market for logs and bolts.

Stumpage

Because of the large number of forest owners and the small size of the average forest holding (less than 70 acres) the stumpage market is a composite of small

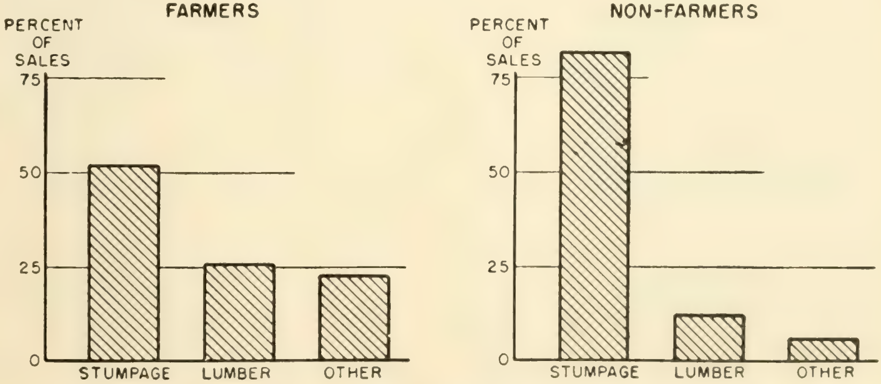

Figure 9. Distribution of sales according to product sold (based on sales of $100 or more).

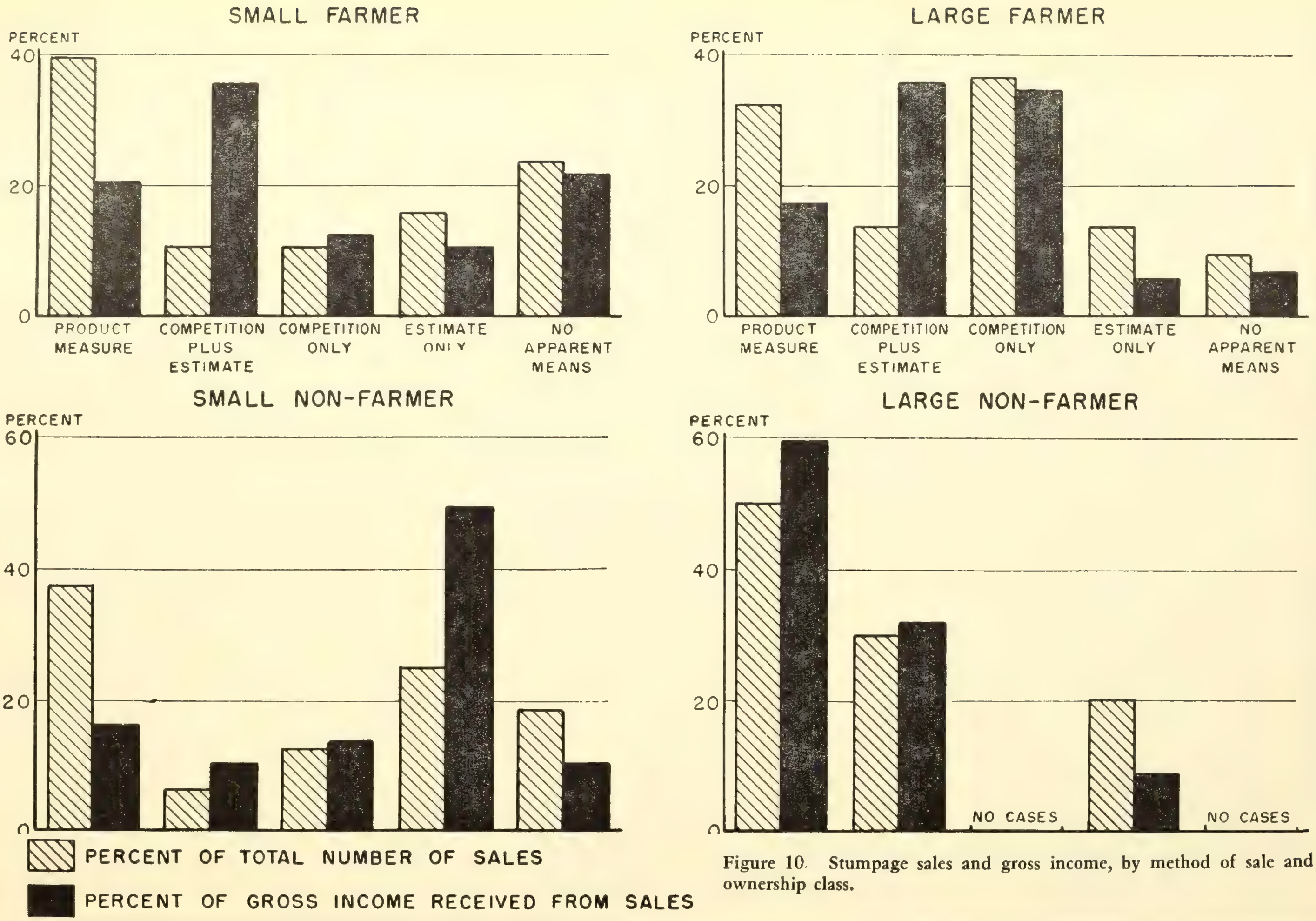

Figure 10. Stumpage sales and gross income, by method of sale and ownership class.

local transactions. The timber owner entering such a market is often hampered by a lack of broad market experience and information.

The number and variety of markets for which a given lot of stumpage may be considered depends primarily upon the volume, size, species, grades, and location of the timber. A portable mill will move into a locality for as little as 20,000 board feet. Once set up, it will consider smaller lots within 5 to 10 miles of the mill. High grade white oak, gum, hickory, and yellow-poplar can also be sold, on the stump, often in relatively small amounts, to specialty buyers. Demand for low-grade hardwoods is limited mainly to times of intense market activity.

The initial step in a stumpage sale, the meeting of the buyer and timber owner, is usually highly informal. Many owners, observing activity in their locality, are enticed to make inquiries of the operators. Typical responses of the owners about this stage of the sale were "I saw a log truck go by and stopped the driver," or "They were cutting next to my place and I went over to see them." Both sellers and buyers often rely on word-of-mouth to spread the news that they are interested in selling or purchasing timber. In the present active market, the owners of the better stands are approached repeatedly by a number of buyers, often for several different products. Owners with only a small volume of material of low quality generally have to take the initiative themselves.

In 35 percent of the sales covered by this study, the need for money was the compelling motive; and of this 35 percent, two-thirds were for some emergency need—as medical bills or burial expenses. Price considerations, repeated visits of a buyer, the presence of a mill nearby—all direct or indirect forms of market pressure —accounted for another 50 percent of the sales. The remainder of the sales was made for land clearing, salvage, and other reasons. Few owners indicated that their sales were for timber management.

In bargaining, most timber owners are familiar with the prices being paid, but are limited by their inability to determine the volumes and quality of the material they have to sell. To protect themselves, some owners resort to sale methods that will place them on a more nearly equal basis with the buyer.

One of these methods, having the buyer cut the timber and pay for the amount he produced, accounted for over one-third of all the sales of both large and small owners. In terms of income received from the sales, the proportion was generally smaller. The large non-farmers were the greatest users of this method (fig. 10).

A substantial portion of all the sales was made through the use of competitive bids, either with or without a prior estimate of value by the owner.

The small non-farmers received nearly one-half of their stumpage income from sales based solely on their own estimate of the volume and quality of their timber. Among the other owners such sales, both in income and in numbers, were less important. Few experienced estimators of volume and quality of timber are found among timber owners. On all but the largest sales, the estimate is usually made personally by the owner or with assistance from friends or neighbors. Such estimates are usually not very accurate. Typically, they take no consideration of quality, but are concerned primarily with arriving at a lump-sum value for the entire tract. The usual basis is by comparison with a similar tract "that Clem Jones sold a while back."

In many sales no bargaining is evident. Some owners dealt with a friend or neighbor. Others thought that the price was satisfactory; or had a pressing monetary need to be satisfied, e. g., "I needed the money to repair my car."

Considering their imperfect knowledge of volume and quality, many owners bargained quite effectively. Before selling his trees on the basis of lumber tally, one enterprising owner visited the slab heaps of mills in his locality in order to determine which mill wasted the least wood in sawing. Some owners were able to induce the buyers to remove the lower grade merchantable material as well as the better grades. Perhaps some evidence of competent bargaining is also found in the frequent complaint of timber buyers that "the landowners want too much for their timber."

The great bulk of agreements between the timber owners and the buyers is informal, being merely verbal pacts.

Written agreements are more commonly used by owners having more than 500 forest acres. On smaller holdings, the use of a written agreement is normally at the buyer's insistence.

Written agreements are usually in the form of timber deeds, which can be obtained at the county court houses. These deeds, in addition to providing for the transfer of the timber in return for the payment of a stated amount, commonly describe the timber included, state the time allowed for removal, and specify the right of the buyer to enter and remove the timber, and to incur damage incidental to logging. A few deeds provide for leaving seed trees (required by the State Timber Harvesting Act), but usually all merchantable trees are included.

In most sales based in whole or part on estimated volumes, payment in full is made before cutting commences. Less often part of the money is paid before cutting and the remainder in installments as cutting progresses. This method is most common in sales based on measured products such as lumber, logs, bolts, or pulpwood units. When volumes are small, payment to the owner is occasionally deferred until the buyer has sold the product.

The most common basis of payment in sales based on a measured product was a lumber tally made by the buyer or subsequent buyer—generally a concentration yard.

Processed Products

The timber owner's part in the market generally ends with the sale of stumpage. However, some owners process and sell lumber, logs, and bolts.

Lumber was sold in 26 percent of the farmers' sales and other products (chiefly logs and pulpwood) in 22 percent. For non-farmers, the sale of lumber comprised only 12 percent and other products but 6 percent of the number of sales (fig. 9).

The small farmers received 41 percent of their gross timber income from the sale of processed timber products. Large farmers received hardly 15 percent of their gross returns from such sales and the non-farmers, both large and small, only 5 percent (fig.10). The prevalence of products sales among small farmers is to some extent a matter of necessity rather than choice. Many of these farmers have insufficient timber to attract a stumpage buyer, and therefore, must sell products if they are to market anything.

Lumber.—Nearly one-third of the lumber sales by the timber owners was of surplus material remaining after building construction. An additional one-third was by owners who operated a sawmill as a supplementary source of income. The remaining sales were for a variety of reasons, such as land clearing or emergency needs.

The usual marketing procedure is for the owner to deliver the lumber—generally custom-sawed by a local mill—to a concentration yard or large mill, with or without prior agreement, and, normally to accept the quoted price. A variation is to pay the sawmill operator an agreed price per unit for marketing as well as sawing the lumber.

Pulpwood and ties.—The timber owner

is usually better equipped to handle and process these smaller products than he is lumber or logs. The acceptable units are easily defined, the buyers and places where the products can be sold are generally well known, and the prices are well established. Nearly 80 percent of the owners knew the current price for pulpwood and where it could be sold. In addition, the timber is often best adapted to these products.

Usually the owner delivers the product to the dealer and accepts the quoted price. Occasionally the owner will inquire about prices and specifications before making delivery. In some localities, the owner stacks the products at the roadside and the dealer periodically picks them up.

Other products.—Markets also exist for lumber and veneer logs and for bolts suitable for handle stock, cooperage, ski blanks, and the like. These markets will accept suitable material in quantities as small as one log or one bolt. However, the average timber owner is limited in both ability and equipment necessary to process and deliver the required material.

Evaluation of the Marketing System

The timber market of northeast Mississippi is characterized by an inadequate supply of raw material, continued heavy demand for merchantable timber, and a marketing system well adapted to the area but hampered by the landowners' lack of interest in, or financial inability to undertake, conservative forest management[3].

Timber Supply

The factor that overshadows all other aspects of the marketing system is that timber owners are not realizing the potential production of their forest land. The forest, which occupies 45 percent of the land, is composed of a wide variety of species and is potentialy capable of producing a variety of raw material. However, the timber is of such quantity and quality that it is suitable for only a restricted range of products. The trend is toward further deterioration and depletion. The rate of depletion is twice that of any other region of the State, a disproportionate amount of growing stock is in low-grade hardwoods, and cull trees are numerous.

The forest is distributed among a large number of individuals, only 1 percent of whom are forest industry owners. This distribution prevents the establishment of large blocks of forest land by industry and thus provides an incentive for the other owners to supply the needs of industry.

Markets

Demand for wood is heavy, and outlets for timber in northeast Mississippi are numerous and widely distributed. The lumber industry utilizes most of the material marketed, and pulpwood procurement is being organized more intensively. Even small quantities of wood are generally marketable. The market for low-grade hardwoods, however, is weak, and the tie market is sporadic. Segregation of material for its highest use is uncommon and such increased returns as result from the segregation that is being practiced are transmitted obscurely, if at all, to the timberland owner. While demand has encouraged the operations of numerous sawmills and the entrance of the landowner into the market, it has also sped the deterioration of the resource.

The Marketing Process

Under pressure of demand for raw material, consumers of timber have developed means of tapping the stands of the small holdings. Individuals and agencies are present who readily undertake procurement, harvesting, and transportation. Small volumes are marketable and opportunities for needed part-time employment are available. However, small volumes and low-quality increase procurement problems and often limit marketing opportunities. Landowners and many of the small processors deal in timber too seldom to develop competence. Small and infrequent returns lead the owner to attach low importance to the timber resource, to its management, and to the marketing of its products. The opportunities present in the area for the landowner to sell more material in processed form are not fully realized. Measurement of volume and quality is lacking in many transactions, and is inadequately determined or unequally available to buyer and seller in others. Improved forms of written agreements are seldom used except in the largest sales.

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[3] Landowners' attitudes toward timber management in a similar portion of the State have been investigated by L. M. James, W. P. Hoffman, and Monty A. Payne, (3). Many of their findings are relevant to northeast Mississippi.

A final consideration, often the most important one, is the limited working capital of many of the timber producers and processors. A high level of timber production requires a deferment of income which the landowner often feels unable to undertake. In many sales, it is the need or desire for immediate cash that determines when the timber is to be sold and how the sale is to be carried out. The small processor's operations are also often adversely affected by similar needs.

Suggestions For Improvement

What needs to be done to improve the timber-marketing situation in northeast Mississippi? Complete solutions of all the difficulties will probably not be achieved until the average income of the area's small landowners increases. Insofar as forestry and timber marketing are concerned, however, there are several courses of action that can profitably be taken.

Management must be improved.—The crying need of the area is for greatly improved timber management. Unless the landowners soon begin to grow more and better trees, some of their present good but restricted markets seem likely to perish from starvation. In fact, there will be a considerable, though temporary, pinch even if management does improve, for the cut will have to be decreased before the stocking of the stands can be increased.

Action can be taken most readily toward narrowing the gap between what foresters already know about timber growing and what the average landowner practices. This calls for strengthening and expanding present programs for educating the landowner in good forest practices and making available a forester's help in applying them. More forestry field days, model farm forests at convenient locations in the area, and other demonstrations would help the landowners to visualize and recognize the goals of improved timber management.

Legislative action to strengthen the State's Timber Harvesting Act and improve its enforcement would be beneficial, especially if accomplished by renewed efforts to acquaint landowners and timber buyers with the benefits the act seeks to ensure.

Research and study to adapt present systems of forest management to the needs of small landowners with limited capital parallel and go hand-in-hand with the action program. The levels of growing stock that such owners can afford to carry in their forests ought to be determined. Some cutting systems should be formulated and tested for those owners who are currently able to carry only a minimum of growing stock but wish to build it up over the years as painlessly as possible. And, at least until a market can be found for the low-grade hardwoods that encumber the area's forests, it will be of immediate practical use to learn the costs of and returns from different intensities of timber stand improvement under various local conditions.

Forest credit possibilities should be studied.—It was evident from this study that the landowners with sizeable volumes of timber to sell generally are best able to bargain effectively and thus increase the returns from their timber lands. The inability of the owner to undertake needed expenditures, or to defer income while building up his stand, holds production to a minimum on many forest properties. Long-term credit at low interest rates would enable these owners to improve and build up their timber enterprises. Studies are needed to establish the values and risk involved, and to determine the cutting restrictions necessary to safeguard such loans. With this information available, lending agencies would be encouraged to expand their efforts in this field.

Timber should be sold by measurement.—Lack of commonly accepted and understood systems of measuring the volume and quality of timber handicaps both buyer and seller in northeast Mississippi, and prevents them from realizing the benefits of established market prices. The advantages of selling timber by measurement should be stressed in action programs, and known methods of measuring and grading should be demonstrated and taught. Simplified methods adapted to the needs of the small landowners should continually be sought.

Material should be put to its highest use.—More of the area's timber should be sorted so that more of the volume of each class and grade is put to the highest and most profitable use it can satisfy. If the added returns possible from separation can be reflected back to the landowners, their incentives for growing timber will be increased, and the maintenance of a variety of markets will be encouraged.

The landowner has opportunity to do considerable sorting himself. More than half his production goes into fuel wood. By cutting the poorer trees for this use he can immediately raise the level of quality of the material left for marketing and with benefit to his stand. Fence posts, too, can be cut from material not suited to other uses, and also treated so that the amount of wood required to maintain fences can be reduced. Action agencies should give continuing emphasis to these matters.

When volumes are large enough, the landowner can divide a stumpage sale among several buyers; for example, high grade white oak can be sold to the cooperage mill, saw timber to the sawmill, tops and smaller trees for pulpwood. Whether volumes are large or small, the owner can reach a variety of markets by producing and sorting logs or bolts himself. As the practice of grading timber is more widely adopted, the landowner will have more opportunity to benefit from prices based on the several grades of material sold.

However, the relatively small volumes involved, the growers' preoccupation with other endeavors, and their general unfamiliarity with products and markets suggest that much of the sorting will be done by agencies that concentrate wood products. A fuller understanding of sorting methods now in use, and of the agencies best adapted to this operation, is required.

In parts of the country where cooperatives have been established, they have usually undertaken the sorting operation. There are no cooperatives marketing timber products in northeast Mississippi, but an investigation should be made to see if the timber growers would support one and to learn what type would best fill their needs.

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An Economic Appraisal of

SHEEP PRODUCTION

In The Northeast Prairie of Mississippi

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TABLE OF CONTENTS

Title — Page

INTRODUCTION 5
- The problem 5
- Method of study 5

SYSTEM OF FARMING 5
- Land use 5
- Cropping pattern 5
- Livestock system 6
- Farm labor supply 6
- Farm equipment 6
- Farm buildings 6

MANAGEMENT PRACTICES 6
- Pastures 6
- Feeding practices 7
- Breeding practices 8
- Buying and selling sheep 8
- Health practices 8
- Labor utilization 8

INVESTMENT, COSTS, AND RETURNS 8
- Investment 8
- Costs 9
- Returns 10

SUMMARY AND CONCLUSIONS 10

APPENDIX I, Method used in calculating investment, costs, and returns 13

APPENDIX II, Statistical Tables 14

LIST OF TABLES

Table — Page

1. Investment in the sheep enterprise per flock and per ewe 9
2. Total cost per flock and per ewe 9
3. Returns and returns to investment per flock and per ewe 10

APPENDIX TABLES

1. Land use 15
2. Cropland utilization 15
3. Age and sex distribution of the family labor force 15
4. Age of operator 15
5. Hours of labor used for the sheep enterprise, per flock and per ewe, by months 15
6. Number and percent of farms having specified types of power and equipment 16
7. Type of buildings used for the sheep enterprise, percent of farms using each type building, replacement cost and replacement cost to the sheep enterprise 16
8. Building cost per flock and per ewe 16
9. Number and percent of farms having other livestock enterprise of commercial importance 16
10. Sheep number 16
11. Land preparation, fertilization and seeding practices, all improved permanent pastures 17
12. Annual land preparation, fertilization and seeding practices, temporary winter pasture 17

Continued

APPENDIX TABLES—(Continued)

Table — Page

13. Percentage of improved permanent pasture improved by specified method, and percentage of temporary grazing crops that were specified crops 17
14. Cost of establishment and annual cost per acre for all improved permanent pasture 18
15. Annual pasture cost per acre, unimproved permanent, woodland, temporary winter, and temporary summer 18
16. Acres of pasture per flock and per ewe and annual pasture cost per flock and per ewe 18
17. Pasture credits per flock and per acre 18
18. Source of water 19
19. Quantities of feed used per flock and per ewe 19
20. Breed of sheep 19
21. Percentage of lambs born by months and sold by months and percentage of animals purchased by months 19
22. Number, liveweight, and value of animals sold per farm 20
23. Liveweight and value of sheep produced per flock and per ewe 20
24. Cause of death of ewes and lambs 20
25. Marketing cost per flock and per ewe 20
26. Miscellaneous cost per flock and per ewe 20

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An Economic Appraisal of Sheep Production in the Northeast Prairie of Mississippi

By D. W. PARVIN

The Problem. Although the sheep enterprise is of minor importance as a source of income on Mississippi farms, it has been increasing in importance in the past decade.[1] A decline in the farm labor supply, relatively low labor requirements for sheep production and relatively high prices for lambs and wool are the major factors contributing to the increased number of sheep on Mississippi farms. The low investment requirements for a one-ram unit as compared to a one-bull unit for beef production was probably a contributing factor on some farms.[2]

It is expected that the demand for meat will continue at a high level and that there will continue to be a shortage of farm labor. Therefore, further increases in sheep numbers on Mississippi farms may be expected. Farmers contemplating adding a sheep enterprise to their present system of farming or expanding their present sheep enterprise need certain basic information on which to base their decisions. This study was designed to provide basic information relating to sheep production on Mississippi farms, particularily the following:

1. The resources used in sheep production and the investment required.
2. The management practices used.
3. The costs and returns involved.
4. Weaknesses in present management practices and ways by which sheep production can be made more profitable.

Method of study. Data for the study were obtained by personal interview with 25 producers in the Prairie section of Clay, Lowndes, and Noxubee Counties. A list of sheep producers was secured from the Agricultural Extension Service and supplemented by agricultural workers in each county. Insofar as possible,[3] all sheep producers were interviewed who owned an average of 10 or more ewes or who sold 10 or more lambs during the year studied. Detailed information with regard to all phases of the sheep enterprise was obtained. Methods used in calculating investment costs and returns are given in Appendix I.

System of Farming

Land use. The farms studied were much larger than the average operating unit in the Northeast Prairie, 880 acres compared to less than 160 acres.[4] (Appendix Table 1). On the farms studied, about seven-eighths of the land was open and about one-eighth wooded. Approximately four out of each 10 acres of open land were devoted to crops and six acres to permanent pasture. Most of the wooded areas were pastured—83 percent.

Cropping pattern. Hay, cotton, temporary winter pasture, and corn were the principal crops (Appendix Table 2). Hay crops occupied almost twice as much land as any other crop. Hay crops were grown on 37 percent of the cropland, cotton on 20 percent, temporary winter pasture on 19 percent and corn on 15 percent. One out of each eight acres of cropland was idle. Sixteen percent of the land was double-cropped, usually with temporary winter pasture and a summer hay crop.

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[1] The number of stock sheep on Mississippi farms increased from 64,000 on January 1, 1941 to 106,000 on January 1, 1951. (Agricultural Statistics, USDA, 1942 and 1951).

[2] As shown in Mississippi Experiment Station Bulletin Number 497, the investment in animals, land and buildings for a one-bull unit of 30 cows was approximately $12,000 in 1950. As shown later in this study, the investment in animals, land and buildings for a one-ram unit of 30 ewes was approximately $2,000 in 1950—one-sixth as much.

[3] If a schedule was not obtained in three visits to a farm, that producer was dropped from the study.

[4] Estimations based on census of 1950.

Livestock system. Eighteen of the 25 operators had been in commercial sheep production 10 years or less. In terms of the overall livestock production program, the sheep enterprise was relatively small. In addition to the sheep enterprise, there was at least one other livestock enterprise of commercial importance on all farms studied; of the 25 farms, 17 had a beef enterprise of commercial importance, 15 had a dairy enterprise of commercial importance and 11 had a hog enterprise of commercial importance (Appendix Table 9).

There was an average of 52.6 ewes per farm (Appendix Table 10). In addition, an average of 44 beef animals and 25 hogs were sold per farm; also, 24 cows were milked per farm.

Farm labor supply. There was an average of 3.4 members of the operator's family on the farm during the year studied (Appendix Table 3). The family labor force was almost equally divided between males and females and about two-thirds were between the ages of 18 and 69. Most of the operators were between 30 and 70 years of age. Only four operators were either below 30 years of age or above 70 years of age (Appendix Table 4).

In addition to the family labor force, most farms had croppers or wage hands, or both. Approximately four-fifths of the cotton and three-fifths of the corn was worked by croppers. The remaining acreage of cotton, corn, and all other crops was handled by the operator's family and wage hands. An average of 579 days of wage work was hired per farm, 72 percent by the day and 28 percent by the month.

Farm equipment. Four-fifths of the farms had both tractors and workstock (Appendix Table 6). Mowers, rakes, discs, and breaking plows were found on almost all farms. Hay balers and lime spreaders were found on about two-thirds of the farms; grain drills and cultipackers on about one-half of the farms; and combines and silage cutters on about one-third of the farms.

Farm buildings. The general barn was used in connection with the sheep enterprise on 13 of the 25 farms studied (Appendix Table 7). A general sheep barn was used on nine farms. Also, in connection with the sheep enterprise, hay barns were used on four farms, cribs on three farms, dog-proof carrols on two farms, and a silo on one farm.

Management Practices

Pastures. The greater part of grazing furnished sheep was in the form of improved permanent pasture.[5] Each ewe was provided with an average of .71 acres of improved permanent pasture, .11 acres of unimproved permanent pasture, .03 acres of woodland pasture, .09 acres of temporary winter pasture and .02 acres of temporary summer pasture (Appendix Table 16).

Of the 25 farms, 22 had made some improvement on open permanent pasture. A complete job of improvement (land preparation, fertilization, and seeding) had been done on 34 percent of the improved permanent pasture (Appendix Table 13). Forty-four percent of the total acreage of improved permanent pasture had been improved by either land preparation, fertilization or seeding or by a combination of two of these practices; 22 percent had been improved by mowing only.

As far as land preparation for improved permanent pasture was concerned, only 41 percent was disced, 3 percent broken with a breaking plow, 32 percent harrowed and 11 percent cultipacked (Appendix Table 11). Almost all producers mowed at least a part of the improved permanent pasture, 86 percent was mowed an average of 1.5 times per acre.

Fertilizers (not including lime) had been applied to 69 percent of the total acreage of improved permanent pasture. Lime had been applied to 14 percent of the acreage. Superphosphate and basic slag were the fertilizers most commonly used. Superphosphate had been applied to 52 percent of the total acreage of improved permanent pasture and basic slag to 25 percent. See Appendix Table 11 for rates per acre where applied.

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[5] Open permanent pasture where the land had been broken, seeded, or fertilized or any combination of these practices. Open permanent pasture that had been mowed every year for the four years immediately preceeding the year studied was also classified as being improved.

Forty-five percent of the improved permanent pasture had been seeded to one or more grasses and legumes. Lespedeza, wild winter peas, White Dutch clover, fescue, and crimson clover were the pasture plants most commonly seeded. Other pasture plants seeded included Dallis grass, Lapacea clover, sericea lespedeza, Ladino clover, black medic, red clover, and Persian clover.[6]

Temporary winter pasture was provided for the sheep enterprise on 13 of the 25 farms studied and averaged about .15 acres per ewe on these farms. Several combinations of winter growing crops were used. However, oats alone or in combination with legumes, and wild winter peas alone were the predominant types of temporary winter pasture. Only 5.3 percent of the total acreage of temporary winter pasture was planted to other crops or combination of crops.[7]

Since wild winter peas do not require annual planting, all land used for this temporary winter pasture was not broken during the year studied. About three-fourths of the total acreage was broken, one-half harrowed and one-fourth cultipacked (Appendix Table 12).

Nitrogen and phosphate were the only fertilizers used on temporary winter pasture. Nitrogen was applied to 51 percent of the acreage at the rate of 44 pounds of nitrogen per acre and phosphate to 15 percent of the acreage at the rate of 76 pounds of P_2O_5 per acre.

Temporary summer pasture was provided for the sheep enterprise on three of the 25 farms studied and averaged .13 acres per ewe on these farms. Johnson grass, sericea lespedeza, and Sudan were the crops used for temporary summer pasture.

The usual practice was to give sheep access to permanent pasture the year around. On the average, grazing on temporary winter pasture was begun the middle of December and continued until the end of March. During this period, animals were allowed to graze temporary winter pasture about three-fourths of the days. On days when grazing was done, the usual grazing period was 24 hours; however, some producers grazed temporary winter pasture a few hours and then removed the flock. Grazing practices varied widely on the three farms having temporary summer pasture.

In addition to the grazing secured, 12 of the 22 producers having improved permanent pastures and eight of the 13 producers having temporary winter pasture harvested hay or seed from these pastures. Hay harvested from improved permanent pasture averaged .24 tons per acre for the total acreage of improved permanent pasture. A small amount of seed (less than four pounds) was also harvested per acre. An average of 9 bushels of oats, 46 pounds of wild winter peas, and 2 pounds of crimson clover seed were harvested per acre from the total acreage of temporary winter pasture. In all, 9 tons of hay, 43 bushels of oats, 302 pounds of wild winter peas, and 49 pounds of other seeds were harvested per farm from the 37.5 acres of improved permanent pasture and 4.8 acres of temporary winter pasture used by the sheep enterprise.

Water for the sheep was supplied by ponds, wells, and creeks (Appendix Table 18). Ponds were used on 80 percent of the farms, wells on 32 percent and creeks on 16 percent. Seven of the 25 flocks had two sources of water.

Feeding practices. Of the 25 flocks, 11 were fed roughage and concentrates, 4 were fed roughages alone, 4 were fed concentrates alone, and 6 were not fed. On the farms where the sheep were fed, feeding was begun on the average about December 20 and continued to about March 20.

Very little feed was given sheep during the year studied. For all flocks, feed per ewe averaged 42 pounds of roughage and 14 pounds of concentrates (Appendix Table 19). Corn and cottonseed meal were the principal concentrates fed; most of roughage fed was hay.

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[6] See Appendix Table 11 for acres applied to and rates per acre where applied.

[7] In addition to oats and wild winter peas, crimson clover, rye grass, and red clover were the only crops seeded.

Breeding practices. Practically all farms had purebred rams and grade ewes. However, about one-half of the producers had at least one registered ram and about one-fourth had some registered ewes. Most of the ewes (80 percent) were classified as Hampshire, Western, Native, or Southdown.[8] Hampshire and Southdown rams were predominant (Appendix Table 20). There was one ram for each 20 ewes.

Eighty-four percent of the lambs were born in the four-month period—December through March—with 56 percent of the births being concentrated in January and February (Appendix Table 21). The lamb crop amounted to 99 percent of the average number of ewes.

Buying and selling sheep. In terms of liveweight, 96.5 percent of the sheep produced were sold. Lambs accounted for 95 percent of sales (Appendix Table 22). Lambs were sold at an average weight of 74 pounds. Almost nine-tenths of the lambs were sold in June, the balance being sold in March, May, and July. All ewes sold were sold in May and June and rams in May, June, and July. Almost all wool marketed was sold in May and June.

For the year studied, ewes purchased amounted to 14 percent and rams purchased to 16 percent of the number on hand at the beginning of the year. Ninety percent of the ewes were purchased from May through August, 60 percent being concentrated in May and June. Eighty percent of the rams were purchased in May and June; the balance in February and August. Only one lamb was purchased on all farms studied.

The production of sheep for a particular year includes lambs raised and sold, lambs raised and kept for replacement, weight put on animals on hand at the beginning of the year under consideration. Therefore, sales, changes in inventory, purchases and the amount slaughtered for home use must be taken into consideration in determining the liveweight of sheep produced. During the year studied, the production of sheep averaged 2,940 pounds per flock or 56 pounds per ewe (Appendix Table 23). In addition, the production of wool amounted to 268 pounds per flock or 5.1 pounds per ewe.

Health practices. The sheep were treated for internal parasites with phenothazine on 24 of the 25 farms studied. In about one-third of the cases, the treatment was salt to which phenothazine had been added. Sheep were sprayed or dipped to control insects on four of the 25 farms.

Death losses for ewes average about 10 percent of the number on hand at the beginning of the year. Approximately one lamb out of each six born died or was killed during the year.

Dogs killed 61 percent of the ewes lost and 35 percent of the lambs lost. Other animals killed another 29 percent of the lambs (Appendix Table 24). Ten percent of the lambs and 2 percent of the ewes froze or starved. Death from old age was responsible for 14 percent of the ewes lost. The cause of death was unknown for 21 percent of the lambs and 12 percent of the ewes. Known cases of death due to parasites and diseases accounted for less than one percent of the lambs lost and for only 5 percent of the ewes lost. Perhaps parasites and diseases were responsible for some deaths the cause of which was listed as unknown.

Labor utilization. Labor used for the sheep enterprise average 138 hours per flock or 2.6 hours per ewe (Appendix Table 5). In general, there was a close correlation between the size of the flock and the number of hours of labor utilized per ewe. Thirteen flocks averaging 24 ewes required 5.3 hours of labor per ewe compared to 2.1 hours of labor per ewe for 12 flocks averaging 91 ewes.

Investment, Costs, and Returns

Investment. Investment in the sheep enterprise included that in the breeding flock, pasture land (including fences), and buildings. These three items averaged $3,444 per flock or $65 per ewe (Table 1).

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[8] The balance were Corriedale, Rambouillet, Shropshire, crosses and mixtures.

Table 1. Investment in the sheep enterprise per flock and per ewe, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Item	Per flock	Per ewe	Percent of total
	Dollars	Dollars	
Breeding flock:			
Ewes	1,012	19.24	29.4
Rams	126	2.39	3.7
Total	1,138	21.63	33.1
Pasture land:			
Improved permanent	1,891	35.95	54.9
Unimproved permanent	137	2.60	4.0
Woodland	11	.21	.3
Temporary winter	124	2.36	3.6
Temporary summer	35	.67	1.0
Total	2,198	41.79	63.8
Buildings:			
General barn	56	1.06	1.6
General sheep barn	44	.84	1.3
Other buildings	8	.15	.2
Total	108	2.05	3.1
Total investment	3,444	65.47	100.0

Table 2. Total cost per flock and per ewe, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Item	Per flock	Per ewe	Percent of total
	Dollars	Dollars	
Pasture [1]	241.81	4.60	58.7
Feed [2]	38.96	.74	9.5
Labor [3]	55.24	1.05	13.4
Buildings [4]	16.49	.31	4.0
Marketing [5]	10.68	.20	2.6
Miscellaneous [6]	48.44	.92	11.8
Total	411.62	7.82	100.00

[1] See Appendix Tables 14, 15, and 16 for detailed cost by types of pasture.

[2] See Appendix Table 19 for quantities and cost of various types of feed.

[3] Calculated by multiplying the hours of labor required per flock and per ewe as shown in Appendix Table 5 by the prevailing wage of 40 cents per hour.

[4] See Appendix Table 8 for details.

[5] See Appendix Table 25 for details.

[6] See Appendix Table 26 for details.

The investment in the breeding flock amounted to $1,138 per flock or 33 percent of the total investment in the sheep enterprise. Investment in the breeding stock averaged $21.63 per ewe of which $19.24 was the value of the ewe; the remaining $2.39 was the ewe's share of the investment in rams.

Almost two-thirds of the total investment in the sheep enterprise was in pasture land. This amounted to $2,198 per flock and $42 per ewe. Improved permanent pasture accounted for almost seven-eighths of this investment.

Buildings used by the sheep enterprise accounted for only 3 percent of the total investment in the enterprise. The investment in building averaged $108 per farm and $2 per ewe. The portion of the general barn used by the sheep enterprise and the general sheep barn accounted for 92.5 percent of the investment in buildings.

Costs. Total cost of the sheep enterprise as calculated in this study includes charges for pastures, feed, buildings, labor, marketing, and miscellaneous items. A charge for interest on investment was not included as a part of the cost of pastures and buildings. Total cost averaged $412 per flock or $7.82 per ewe (Table 2).

The annual cost of pastures accounted for almost three-fifths of the total cost of the sheep enterprise. Annual pasture cost averaged $242 per flock or $4.60 per ewe. The annual cost of improved permanent pasture accounted for 66 percent of total pasture cost; temporary winter pasture acounted for another 27 percent.

The cost of purchased feed plus the market value of home-grown feed fed to the sheep enterprise amounted to $39 per flock or $0.74 per ewe. This was 9.5 percent of the total cost of the enterprise. The total cost of feed was divided almost equally between concentrates and roughages.

At least a part of the labor used in taking care of the sheep on some farms was hired; therefore, all labor used was included as an item of cost. In those cases where the operator and his family took care of the sheep or plan to take care of sheep, a more accurate picture of the costs involved may be obtained by deducing the labor cost from total cost. Labor cost per flock amounted to $55 or 13.4 percent of the total cost of the enterprise. Labor cost per ewe averaged $1.05.

The annual cost of buildings for the year studied averaged $16.49 per flock or $0.31 per ewe. This was 4 percent of the total cost of the enterprise.

The cost of marketing sheep, lambs, and wool, including such items as commission fees, hauling, etc., amounted to $10.68 per flock or 2.4 percent of the total cost of the enterprise. The cost of marketing per ewe was $0.20.

Miscellaneous cost items such as shearing, taxes, veterinary fees and medicine, salt, feed grinding, etc., amounted to $48 per flock or $0.92 per ewe. Miscellaneous items accounted for about 12 percent of the total cost of the enterprise.

Returns. Total returns averaged $1,046 per flock or $19.89 per ewe. The value of animals produced accounted for 74 percent of total returns, the value of wool produced for 11 percent and pasture credits for 15 percent (Table 3).

The difference between total returns and total costs as calculated in this study represents the return to the operator for capital invested in the enterprise and for management of the enterprise. Returns to investment averaged $635 per flock or $12.07 per ewe. The percentage return on capital invested in the sheep enterprise averaged 18.43.

Summary and Conclusions

This study of the sheep enterprise on 25 farms in the Northeast Prairie was made for the purpose of providing present and prospective sheep producers with basic information relative to (1) the resources used in sheep production and the average investment required, (2) the usual management practices, (3) the average costs and returns, and (4) ways by which sheep production can be made more profitable.

The farms studied were much larger than the average operating unit in the Northeast Prairie. Most of the land was open and about six out of each ten acres were used for pasture and grazing crops. Hay, cotton, temporary winter pasture, and corn were the principal crops grown. In terms of the overall livestock production program, the sheep enterprise, which averaged 53 ewes per flock, was relatively small.

In addition to the family labor force of 3.4 persons, most farms had croppers or wage hands or both. Four-fifths of the farms studied used both tractors and workstock as sources of power. A general barn or a general sheep barn were the buildings most commonly used for the sheep enterprise.

The greater part of the grazing furnished sheep was in the form of improved permanent pasture. Each ewe was provided with an average of .71 acres of improved permanent pasture, .11 acres of unimproved permanent pasture, .03 acres of woodland pasture, .09 acres of temporary winter pasture, and .02 acres of temporary summer pasture.

A complete job of improvement (land preparation, fertilization, and seeding) had been done on 34 percent of the improved permanent pasture. Taking into consideration the total acreage of improved permanent pasture, about 43 percent was broken, 69 percent fertilized, 14 percent limed, and 45 percent seeded. Lespedeza, wild winter peas, White Dutch clover, fes-

Table 3. Returns and returns to investment per flock and per ewe, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Item	Per flock	Per ewe	Percent of total
	Dollars	Dollars	
Value of animals produced	776.44	14.76	74.21
Value of wool produced	115.72	2.20	11.06
Pasture credits	154.10	2.93	14.73
Total returns	1,046.26	19.89	100.00
Less total cost	411.62	7.82	
Returns to investment	634.64	12.07	
Percent returned to investment			18.43

cue, and crimson clover were the pasture plants most commonly seeded.

Temporary winter pasture was provided for the sheep enterprise on 13 of the 25 farms studied and averaged about .15 acres per ewe on these farms. Oats alone, oats in combination with legumes, and wild winter peas were the predominant types of temporary winter pasture. Temporary summer pasture was provided for sheep on three of the 25 farms and averaged .13 acres per ewe on these farms; Johnson grass, sericea lespedeza, and Sudan were the crops used.

The usual practice was to give sheep access to permanent pasture the year around. On the average, grazing on temporary winter pasture was begun the middle of December and continued until the end of March. During this period, sheep were placed on temporary winter pasture an average of three days out of four; the usual grazing period was 24 hours per day.

In addition to the grazing secured, 12 of the 22 producers having improved permanent pasture and eight of the 13 producers having temporary winter pasture harvested hay or seed or both from these pastures. Nine tons of hay, 43 bushels of oats, 302 pounds of wild winter peas, and 49 pounds of other seed were harvested per farm from the 37.5 acres of improved permanent pasture and 4.8 acres of temporary winter pasture used by the sheep.

The sheep were not fed concentrates or roughage on six of the 25 farms studied. On the farms where the sheep were fed, feeding was begun on the average about December 20 and continued to about March 20. For all flocks studied, feed per ewe averaged 42 pounds of roughage and 14 pounds of concentrates.

Purebred rams and grade ewes were the usual breeding stock. However, in a few cases, the ram and a part or all of the ewes were registered. There was one ram for each 20 ewes. Eighty-four percent of the lambs were born from December through March, with 56 percent of the births concentrated in January and February. The lamb crop amounted to 99 percent of the average number of ewes.

During the year studied, the production of sheep averaged 2,940 pounds per flock and 56 pounds per ewe. In addition, 268 pounds of wool were produced per flock which amounted to 5.1 pounds per ewe.

Practically all lambs were sold in June. All ewes and most of the wool was marketed in May and June. Lambs were sold at an average weight of 74 pounds. Ninety percent of the ewes purchased and 80 percent of the rams purchased were purchased in May and June. Only one lamb was purchased on all farms studied.

Sheep were treated for internal parasites on 24 of the 25 farms, and sprayed or dipped for insect control on four. Death losses for ewes averaged about 10 percent and about one lamb out of each six born was lost during the year. Sixty-one percent of the ewes lost were killed by dogs and 64 percent of the lambs lost were killed by dogs and other animals. Known cases of death due to parasites and diseases accounted for less than 1 percent of lamb losses and for only 5 percent of the ewes lost.

Labor used for the sheep enterprise averaged 138 hours per flock or 2.6 hours per ewe.

Investment in the sheep enterprise averaged $3,444 per flock or $65 per ewe. Thirty-three percent of the total investment was in breeding stock, 64 percent in pasture land, and 3 percent in buildings.

Total cost of the sheep enterprise, not including a charge for interest on investment, amounted to $412 per flock or $7.82 per ewe. Pastures were the major cost item accounting for about three-fifths of all cost; feed, labor, building, marketing charges, and miscellaneous items accounted for the balance.

Total returns averaged $1,046 per flock or $19.89 per ewe. Returns to investment amounted to $635 per flock and $12.07 per ewe. The percentage return on capital invested in the sheep enterprise averaged 18.4.

Most phases of the sheep enterprise appear to have been managed with a reasonable degree of efficiency as evidenced by the favorable return on capital invested. Pastures, the major cost item, were fairly well stocked, and in most cases where surplus grazing existed, hay or seed were harvested which served to help keep the net cost of grazing low. When the value of hay and seed saved from pastures ($2.93 per ewe) is deducted from total pasture cost ($4.60 per ewe), and the remaining $1.67 is the net cost of pastures per ewe. The acres of pasture used per ewe could have been reduced by heavier stocking; however, this would have reduced or eliminated pasture credits and increased the problem of feeding during the months when grazing normally is limited. The cost of feed, labor, buildings, marketing and miscellaneous items was relatively low per ewe. The lamb crop of 99 percent was satisfactory.

High death losses appear to have been the major weakness in the management of the sheep enterprise. Most of these deaths could have been prevented by protecting the sheep from dogs and other killers, especially at night, by giving the animals better care during the winter and lambing season, and by culling out old ewes. The cause of death should be determined in all cases in order to try to prevent similar losses. Perhaps the average weight of lambs sold could be increased by having more of them dropped early in the lambing season and by the selection of better ewes. Also, more attention to the feeding program in the month prior to lambing should result in stronger lambs and ewes and heavier lambs at market time.

APPENDIX I

Methods Used In Calculating Investment, Costs, and Returns

A. Investment

1. **Breeding stock:** The average number of each class of sheep was calculated from the number on hand at the beginning and at the end of the year. Investment in the breeding stock was determined from the average number of each class of animals and producer estimates of the value of each class at the end of the year. An allowance was made on each farm for changes in weight of each class of animal.

2. **Land:** Acreage of pasture land used by sheep was calculated by prorating the total acreage, on the basis of grazing secured, between sheep and other livestock. Investment in pasture land was based on the number of acres used by sheep and producer estimates of value per acre which included the value of fences. Only one-half of the value of land double-cropped was included in the investment. Woodland pasture was valued for grazing purposes only.

3. **Buildings:** It was assumed that the average investment in buildings would approximate one-half of the replacement cost. Investment in buildings was based on this assumption and on producer estimates of replacement cost. Investment in buildings used jointly with other livestock was prorated on the basis of the proportion used for the sheep enterprise.

B. Costs

1. **Feed:** Feed costs were based on producer estimates of quantities fed and the average price of each kind of feed. The price used for home-grown feeds was the price paid farmers during the harvest season.

2. **Pasture:** Pasture cost was based on the acreage used by the sheep enterprise and the annual cost per acre of each type of pasture. In calculating pasture costs, labor was calculated at the prevailing wage rate of 40 cents per hour; machinery cost was based on farm management cost studies; fencing cost was based on producer estimates as to the materials, labor, and equipment used and prevailing prices; and seed and fetrilizer costs were calculated by using average prices for the year studied and producer information as to quantities used.

In calculating the total cost of improved permanent pasture, the total cost of improvements made was calculated on the basis of July 1949-June 1950 prices regardless of the year in which the improvement was made. Because of wide differences in P.M.A. payments rates in different years and in the different counties, no deduction from total pasture cost for these payments was made.

Upon the recommendations of agronomists the annual charges for seed, fertilizer, and land preparation for improved permanent pasture were calculated as follows: (1) seed, one-tenth of the total cost; (2) land preparation except applying fertilizer, one-tenth of the total cost; and (3) cost of fertilizer and the cost of applying fertilizer was calculated as follows: the total cost of nitrogen was charged to the year applied; 40 percent of the total cost of phosphate, potash and basic slag were charged to the year applied, 40 percent to the following year and 20 percent to the third year; and 20 percent of the total cost of lime was charged to each of the first four years after its application, 10 percent to the fifth year and 10 percent to the sixth year. In addition, the annual cost of improved permanent pasture included mowing and fencing.

3. **Building:** Building cost included depreciation and repairs. The annual charge for depreciation was calculated by the straight-line method; charges for repairs were based on farm management cost studies and were calculated at 3 percent of replacement cost.

4. **Labor:** Labor cost was based on producer estimates of time spent on the sheep enterprise and the prevailing wage rate (40 cents per hour).

5. **Marketing:** Marketing cost was based on producer information as to commission fees and other marketing costs.

6. **Miscellaneous:** Miscellaneous cost was based on producer information as to these costs or as to the quantities of miscellaneous items used and the average price of these items.

C. Receipts

1. **Sheep Production:** Receipts from the production of sheep were calculated by adding the value of animals sold, animals killed for food, and inventory changes and subtracting the value of animals purchased. In calculating the value of inventory changes, increases or decreases in inventory were valued at prices per pound prevailing at the end of the year.

2. **Wool Production:** Receipts from the production of wool were calculated by adding the value of wool sold to the value of the change in the inventory of wool.

3. **Pasture Credits:** Pasture credits were based on producer estimates as to the quantity of hay and seeds harvested from pasture land charged to the sheep enterprise and prevailing prices for these items. The average price received for these items was discounted by an amount equal to the cost of harvesting.

APPENDIX II

Statistical Tables

Appendix Table 1. Land use, 25 farms having sheep enterprise, Northeast Prairie, July 1949 - June 1950.

Item	Acres per farm	Percent of total
Acres owned	772	87.7
Acres rented in	136	15.5
Acres rented out	28	3.2
Acres operated	880	100.0
Cropland	295	33.5
Improved permanent pasture	326	37.1
Unimproved permanent pasture	132	15.0
Woodland pasture	89	10.0
Woodland	18	2.0
Farmstead and other	20	2.3

Appendix Table 2. Cropland utilization, 25 farms having sheep enterprise, Northeast Prairie, July 1949 - June 1950.

Item	Acres per farm	Percent of total
Cotton [1]	58	19.7
Corn [2]	45	15.2
Hay	109	36.9
Temporary winter pasture	56	19.0
Other crops	36	12.2
Idle cropland	38	12.9
Land double-cropped	47	15.9
Total cropland	295	100.0

[1] Croppers worked 45 acres or 78 percent of the 58 acres of cotton.

[2] Croppers worked 28 acres or 62 percent of the 45 acres of corn.

Appendix Table 3. Age and sex distribution of the family labor force, 25 farms having sheep enterprise, Northeast Prairie, July 1949 - June 1950.

Age group	Males	Females	Total males and females
		Number per farm	
Under 9	.12	.16	.28
9 - 12	.16	.08	.24
13 - 17	.28	.32	.60
18 - 59	1.04	.92	1.96
60 - 69	.12	.12	.24
70 and above	—	.08	.08
Total	1.72	1.68	3.40

[1] In addition to the family labor force, 579 days of labor were hired per farm of which 28 percent was hired by the month.

Appendix Table 4. Age of operator, 25 farms having sheep enterprise, Northeast Prairie, July 1949 - June 1950.

Age of operator	Number of farms	Percent of farms
Under 20	1	4
20 - 29	1	4
30 - 39	3	12
40 - 49	6	24
50 - 59	9	36
60 - 69	3	12
70 and above	2	8
Total	25	100

Appendix Table 5. Hours of labor used for the sheep enterprise, per flock and per ewe, by months, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Month	Total per flock	Total per ewe
January	21.6	.41
February	17.6	.33
March	13.6	.26
April	12.6	.24
May	19.1	.36
June	7.8	.15
July	6.4	.12
August	6.4	.12
September	6.2	.12
October	6.5	.12
November	7.3	.14
December	13.0	.25
Total	138.1	2.62

[1] For 12 farms averaging 91 ewes, the hours of labor required per flock and per ewe were 188 and 2.07, respectively; for 13 farms averaging 24 ewes, the hours of labor required per flock and per ewe were 127 and 5.29, respectively.

Appendix Table 6. Number and percent of farms having specified types of power and equipment, 25 farms having sheep enterprise, Northeast Prairie, July 1949 - June 1950.

Item	Number of farms having	Percent of farms having
Workstock	23	92
Tractor	21	84
Disc	23	92
Breaking plow	22	88
Grain drill	12	48
Lime spreader	16	64
Cultipacker	13	52
Mower	24	96
Rake	24	96
Baler	16	64
Combine	8	32
Silage cutter	8	32

Appendix Table 7. Type of buildings used for the sheep enterprise, percent of farms using each type building, replacement cost and replacement cost to the sheep enterprise, 25 farms having sheep enterprise, Northeast Prairie, July 1949 - June 1950.

Item	Percent of farms using	Replacement cost per farm	Replacement cost per flock
		Dollars	Dollars
General barn	56	1,432	111
General sheep barn [1]	36	87	87
Hay barn	16	256	9
Crib	12	15	2
Dog-proof corral	8	4	4
Silo	4	40	2
Total	100	1,834	215

[1] Closed, 8; open, 1.

Appendix Table 8. Building cost per flock and per ewe, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Item	Per flock	Per ewe
	Dollars	
Depreciation	10.04	.19
Repairs	6.45	.12
Total	16.49	.31

Appendix Table 9. Number and percent of farms having other livestock enterprise [1] of commercial importance, 25 farms having sheep enterprise, Northeast Prairie, July 1949-June 1950.

Item	Number of farms having	Percent of farms having
Beef cattle [2]	17	68
Dairy cattle [3]	15	60
Hogs [2]	11	44

[1] Only one farm had as many as 300 laying hens. Two farms sold 500 or more turkeys.
[2] Selling 10 or more animals; 44 beef animals and 25 hogs were sold per farm studied.
[3] Milking 10 or more cows; 24 cows were milked per farm studied.

Appendix Table 10. Sheep number, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Item	On hand July 1, 1949	Born	Purchased	Home use	Sold	Died	On hand June 30, 1950	Average of inventories
				Number per flock				
Ewes	50.5	—	7.2	—	.7	5.0	54.7	52.6
Lambs	6.8	52.0	*[1]	.8	36.4	8.3	9.6	8.2
Rams	2.5	—	.4	—	.1	.4	2.7	2.6
Wethers	.4	—	—	.4	.5	—	.2	.3
Total	60.2	52.0	7.6	1.2	37.7	13.7	67.2	63.7

[1] Less than .05. Only one lamb purchased on all farms.

Appendix Table 11. Land preparation, fertilization and seeding practices, all improved permanent pastures, 25 farms having sheep enterprises, Northeast Prairie, July 1949 - June 1950.

Item	Percentage of total acreage covered	Times over or rate when performed [1]
Land preparation:		
Discing	41	1.7
Breaking	3	1.0
Harrowing	32	1.4
Cultipacking	11	1.4
Fertilizing	69	1.3
Limeing	14	1.0
Seeding	45	1.1
Mowing	86	1.5
Fertilization:		
Lime	14	1920
Basic slag	25	502
Nitrogen (N)	1	46
Phosphate (P_2O_5)	52	74
Potash (K_2O)	1	124
Mixed fertilizers [2]	4	115
Seeding:		
Lespedeza	19	22.6
Wild winter peas	17	44.3
White Dutch clover	4	9.4
Fescue	2	11.3
Crimson clover	2	6.3
Dallis grass	1	7.7
Lapacea clover	1	13.9
Sericea lespedeza	1	30.1
Ladino clover	*[3]	4.5
Black medic	*[3]	6.7
Red clover	*[3]	18.8
Persian clover	*[3]	1.0

[1] Times once over for land preparation where performed and pounds of fertilizer and seed per acre where applied.

[2] Includes 0-14-7, 0-14-2, and 6-8-4.

[3] Less than .5 percent.

Appendix Table 12. Annual land preparation, fertilization and seeding practices, temporary winter pasture, 25 farms having sheep enterprise, Northeast Prairie, July 1949 - June 1950.

Item	Percentage of total acreage covered	Times over or rate when performed
Land preparation:		
Discing	71	1.82
Breaking	17	1.00
Harrowing	49	1.16
Cultipacking	26	1.00
Fertilizing	62	1.06
Seeding	73	1.20
Fertilization:		
Nitrogen (N)	51	44
Phosphate (P_2O_5)	15	76
Seeding:		
Oats	62	111
Wild winter peas	51	41
Crimson clover	15	9
Rye grass	2	15
Red clover	2	12

Appendix Table 13. Percentage of improved permanent pasture improved by specified method, and percentage of temporary grazing crops that were specified crops, 25 farms having sheep enterprise, Northeast Prairie, July 1949 - June 1950.

Item	Percentage of total acreage
Permanent pasture improved by:	
Fertilization, seeding and land preparation	34.1
Either fertilization, seeding or land preparation or a combination of two of these methods	44.1
Mowing	21.8
Total	100.0
Temporary winter pasture seeded to:	
Oats	32.8
Oats and some legume	27.1
Wild winter peas	34.8
Other	5.3
Total	100.0
Temporary summer pasture:	
Sudan	57.7
Johnson grass	26.9
Lespedeza sericea	15.4
Total	100.0

Appendix Table 14. Cost of establishment and annual cost per acre for all improved permanent pasture, 25 farms having sheep enterprise, Northeast Prairie, July 1949 - June 1950.

Item	Cost of establishment	Annual cost
	Dollars	Dollars
Land preparation	2.36	.40
Fertilizer	4.14	1.24
Seed	2.80	.28
Bushing	.03	.01
Fencing	—	.74
Mowing	—	1.59
Total	9.33	4.26 [1]

[1] When interest is charged at 5 percent on the investment in land and fences, the annual cost per acre is $6.78.

Appendix Table 15. Annual pasture cost per acre, unimproved permanent, woodland, temporary winter and temporary summer, 25 farms having sheep enterprise, Northeast Prairie, July 1949 - June 1950.

Item	Unimproved permanent	Woodland	Temporary winter	Temporary summer
		Dollars		
Land preparation	—	—	3.49	3.54
Fertilizer	—	—	3.75	4.04
Seed	—	—	5.82	3.62
Fencing	.56	.67	.50	.73
Mowing	—	—	—	.69
Total [1]	.56	.67	13.56	12.62

[1] When interest is charged at 5 percent on the investment in land and fences, the annual cost per acre is as follows: $6.78, $1.78, $0.96, $14.85, and $14.35 for improved premanent, unimproved permanent, woodland, temporary winter, and temporary summer pasture, respectfively.

Appendix Table 16. Acres of pasture per flock and per ewe and annual pasture cost per flock and per ewe, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Type of pasture	Per flock		Per ewe	
	Acres	Cost	Acres	Cost
		Dollars		Dollars
Improved permanent	37.5	159.75	.71	3.04
Unimproved permanent	5.6	3.14	.11	.06
Woodland	1.8	1.21	.03	.02
Temporary winter	4.8	65.09	.09	1.24
Temporary summer	1.0	12.62	.02	.24
Total	50.7	241.81	.96	4.60

Appendix Table 17. Pasture credits per flock and per acre, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Item	Unit	Quantity		Value	
		Per flock	Per acre	Per flock	Per acre
				Dollars	
Improved permanent pasture:					
Hay	ton	9.00	.24	85.88	2.29
Wild winter peas	lb.	83.62	2.23	5.85	.16
Korean lespedeza	lb.	22.88	.61	2.06	.05
Sericea lespedeza	lb.	6.75	.18	1.89	.05
Lapacea clover	lb.	4.12	.11	2.47	.06
Dallis grass	lb.	3.38	.09	1.69	.05
Fescue	lb.	1.12	.03	.69	.02
Total				100.53	2.68
Temporary winter pasture:					
Oats	bu.	42.86	8.93	30.86	6.43
Wild winter peas	lb.	218.83	45.59	15.32	3.19
Crimson clover	lb.	10.27	2.14	7.39	1.54
Total				53.57	11.16
Total all pasture credits				154.10	

Appendix Table 18. Source of water, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Source of water	Number of flocks	Percent of farms
Pond	13	52
Pond and well	4	16
Pond and creek	3	12
Well	4	16
Creek	1	4
Total	25	100

Appendix Table 19. Quantities of feed used per flock and per ewe, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Item	Per farm		Per ewe	
	Amount	Value	Amount	Value
	Pounds	Dollars	Pounds	Dollars
Concentrates:				
Cottonseed meal	201	6.76	3.82	.13
Corn	338	6.92	6.43	.13
Oats	77	2.12	1.46	.04
Dairy feed	92	3.64	1.75	.07
Soybeans	4	.12	.08	*[2]
Wheat bran	21	.72	.40	.01
Total	733	20.28	13.94	.38
Roughage:				
Hay [3]	1,921	16.44	36.52	.32
Silage	840	2.24	15.97	.04
Total [4]	2,201	18.68	41.84	.36
Total		38.96		.74

[1] The average feeding period was from December 21 through March 18.

[2] Less than $0.005.

[3] Includes 97 pounds of crushed corn cobs and shucks.

[4] Silage converted to hay equivalent.

Appendix Table 20. Breed of sheep, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Breed	Ewes [1]	Rams [2]
	Percent of total	
Hampshire	28.1	55.4
Native	18.3	—
Western [3]	16.6	—
Southdown	15.7	23.1
Corriedale	4.2	—
Rambouillet	3.8	—
Shropshire	—	3.1
Crosses	7.3	9.2
Mixed flocks	6.0	9.2
Total	100.0	100.0

[1] Four farms had purebred ewes and two farms had a part of their ewes registered.

[2] Twenty-three farms had at least one purebred ram and 13 had at least one registered ram.

[3] Includes Texas ewes.

Appendix Table 21. Percentage of lambs born by months and sold by months and percentage of animals purchased by months, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Month	Lambs born	Lambs sold [1]	Ewes purchased [2]	Rams purchased
	Percentage each month			
January	30.2	—	—	—
February	26.4	—	10.6	10.0
March	13.5	5.5	—	—
April	4.5	—	—	—
May	1.6	4.3	33.5	20.0
June	.7	88.9	27.9	60.0
July	.6	1.3	9.0	—
August	.6	—	19.0	10.0
September	.6	—	—	—
October	.5	—	—	—
November	6.7	—	—	—
December	14.1	—	—	—
Total	100.0	100.0	100.0	100.0

[1] All ewes were sold in May and June and rams in May, June, and July; almost all wool marketed was sold in May and June.

[2] Only one lamb was purchased on all farms.

Appendix Table 22. Number, liveweight, and value of animals sold per farm, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Item	Number sold	Liveweight sold	Value of animals sold
		Pounds	Dollars
Ewes	.7	68	11.80
Lambs	36.4	2,702	704.40
Rams	.1	16	3.04
Wethers	.5	52	15.16
Total	37.7	2,838	734.40

Appendix Table 23. Liveweight and value of sheep produced per flock and per ewe, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Item	Liveweight	Value
	Pounds	Dollars
Sales	2,838	734.40
Plus or minus change in inventory	+ 726	+140.08
Plus amount used in the home	+ 103	+ 25.68
Minus purchases	— 727	—123.72
Net production per farm [1]	2,940	776.44
Net production per ewe [1]	56	14.76

[1] In addition, 268 pounds of wool valued at $115.72 was produced per farm; this was 5.1 pounds valued at $2.20 per ewe.

Appendix Table 24. Cause of death of ewes and lambs, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Cause	Percent of animals dying	
	Ewes	Lambs
Killed by dogs	60.8	34.5
Killed by hogs, cows, and horses	—	9.4
Killed by buzzards	—	19.6
Frozen or starved	2.4	9.9
Old age	14.4	—
Diseases and parasites	4.8	.5
Unknown	12.0	21.2
Other	5.6 [1]	4.9 [2]
Total	100.0	100.0

[1] Includes bloat, heat, constipation, lambing, and strangled.

[2] Includes lambing, castration, drowned, and killed by automobile.

Appendix Table 25. Marketing cost per flock and per ewe, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Item	Per flock	Per ewe
	Dollars	
Commission fees	3.80	.07
Hauling	5.40	.10
Other marketing charges	1.48	.03
Total	10.68	.20

Appendix Table 26. Miscellaneous cost per flock and per ewe, 25 farm flocks, Northeast Prairie, July 1949 - June 1950.

Item	Per flock	Per ewe
	Dollars	
Shearing	14.60	.28
Taxes	12.44	.24
Veterinary fees and medicine	9.08	.17
Salt (common and medical)	5.28	.10
Feed grinding	1.52	.03
Automobile	1.48	.03
Insurance on buildings	1.36	.03
Electricity and telephone	1.24	.02
Spray material and disinfectants	.80	.01
Minerals	.64	.01
Total	48.44	.92

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Sunflower County Soils

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

SOIL SURVEY PARTY FOR SUNFLOWER COUNTY

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The above surveyors participated in the mapping of Sunflower County.

Cover photographs and several others in this bulletin used by courtesy of the Soil Conservation Service.

CONTENTS

Page

Introduction 5

General Information on Sunflower County Soils 6

Physiography, Relief, and Drainage 8

Vegetation 9

Agriculture 9

Soil Survey Methods and Definitions 10

Know Your Soils and Plan Their Management 11

First Examine the Soil Map 11

Four Important Points of Soil Management 13

Know the Specific Problems of Your Soils 21

Soil Groups of Sunflower County—Their Use and Management 21

The Value of a Soil Map in Preparing a Farm Plan and Operating a Farm 26

Soil Series and Soil Types of Sunflower County 30

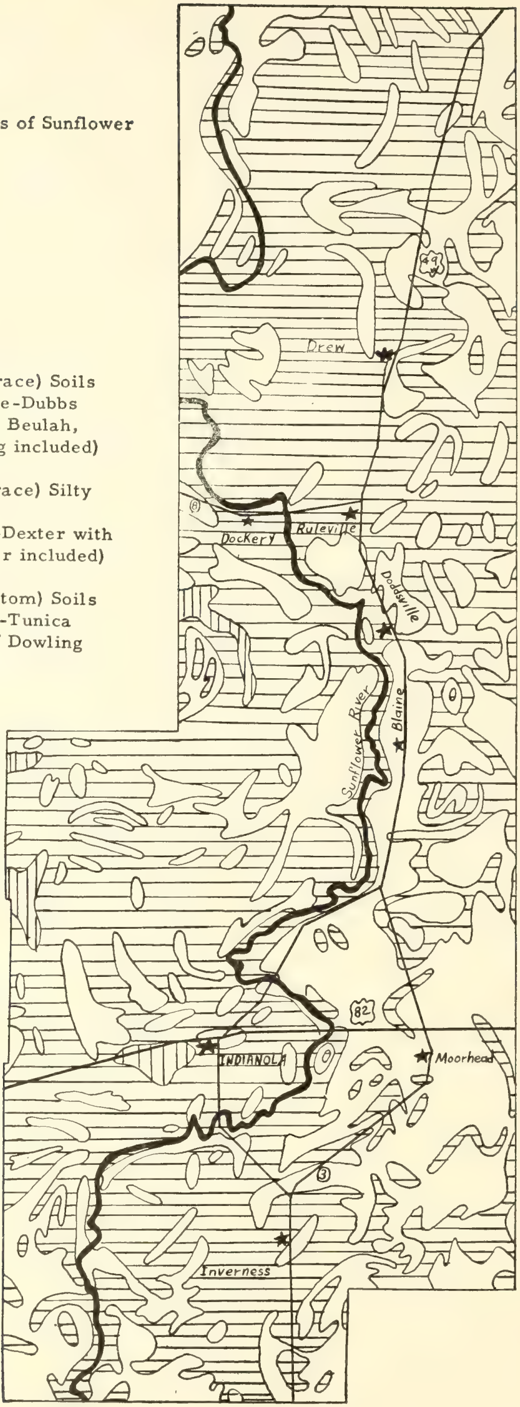
Index 39

Figure 1. Major Soil Groups of Sunflower County.

▤ Stratified (Low Terrace) Soils (Forestdale-Dundee-Dubbs with some Bosket, Beulah, Souva, and Dowling included)

▥ Stratified (Low Terrace) Silty Soils (Brittain-Pearson-Dexter with small areas of Dyer included)

☐ Slackwater (Low Bottom) Soils (Alligator-Sharkey-Tunica with many areas of Dowling included)


8
49
Drew
8
Dockery
Ruleville
Dodsville
Sunflower River
Blaine
82
INDIANOLA
Moorhead
3
Inverness

SUNFLOWER COUNTY SOILS

By J. C. POWELL and H. B. VANDERFORD

This soil report is written primarily for the farmers of Sunflower County. It has been prepared to accompany the soil map of each farm as a summary of the county's soil survey program. The recommendations for management and land use are based on field experiments of the Mississippi Agricultural Experiment Station, observation and field studies, and the experience of good farmers. Suggestions are included regarding secondary drainage, field arrangement, row direction, road and turnrow location, crop adaptability, and treatments for each soil type.

All soils of this county were derived from material deposited by the Mississippi River or its tributaries. This material (called Mississippi River alluvium) is composed predominantly of sand, silt, and clay in varying proportions. To recognize these constituents rub the damp soil between the fingers. Sand, the largest and heaviest of the soil particles, has a gritty feel. Silt, the medium size soil particle, has a very smooth feel like flour or powder. Clay, the smallest soil particle by size and weight, has a very sticky or plastic feel.

Soils that contain a high percentage of sand in their surface and subsoil layers are referred to as coarse-textured soils; whereas, soils with a high percentage of clay in their surface and subsoil layers are called fine-textured soils.

The soils of this county may be divided into four major soil groups. These groups are

1. Stratified (low terrace) loamy group. These soils were derived from a mixture of sand, silt, and clay material and occur on the old natural levee formations. These soils have been free from overflows long enough to have some profile development and have been in place long enough to be partially leached. These productive soils are usually medium acid or sour and are adapted to a wide variety of crops. They are called sandy or mixed land and represent approximately 50 percent of the county's total land area (see figure 1). This group of soils is comprised predominantly of the Forestdale, Dundee, and Dubbs soil series with a few small areas of the Bosket and Beulah soil series.

2. Stratified (low terrace) silty group. These soils were derived from silty parent material on the old natural levee formations. They, reflecting the influence of their parent material, are silty throughout their profiles. Like group one, these soils have had some profile development and are medium acid. These soils respond well to good management and are productive soils, being adapted to a wide variety of crops. They represent slightly less than 1% of the county's total land area (see figure 1). This group is comprised of the Brittain, Pearson, and Dexter soil series.

3. Slackwater (low bottom) group. These soils were derived from clay material in the wide flats or on low ridges in the "backwater" areas. The poor physical characteristics of these soils (such

In using this bulletin with a soil map in Sunflower County, follows the instructions listed below for easy reference:

1. Locate the boundary of your farm on the soil map.
2. Note soil numbers on your soil map. Determine the class of your land by locating these numbers in the index of this buelltin.
3. The index will also give the page number where the use and management of the soil class is discussed.
4. For further information, turn to the table of contents.

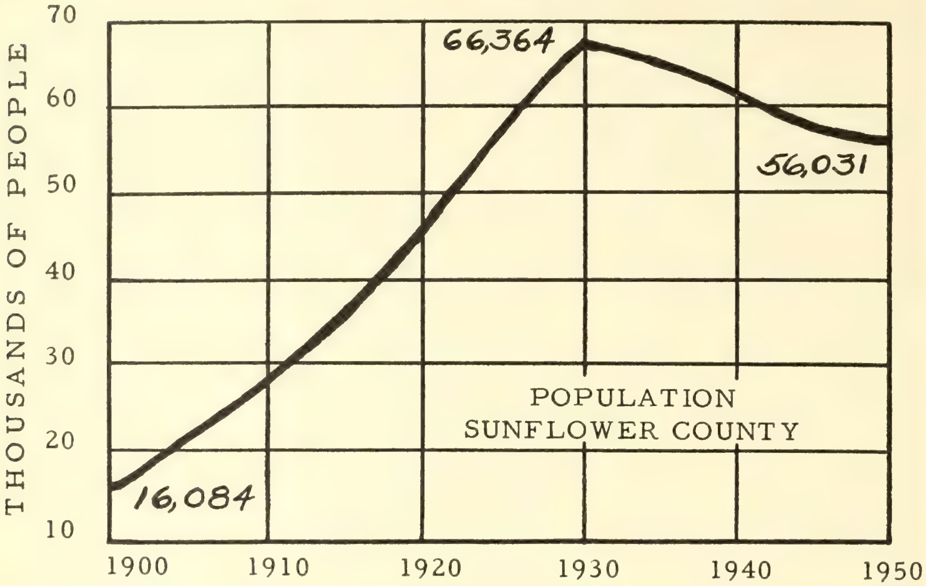


Figure 2. In this agricultural county, a decline in population would naturally follow the adoption of modern mechanized farming methods. Many fields used for cotton production in 1930 are now planted to pastures, soybeans, rice, and other crops that require much less labor than cotton.

as fine textures, poor internal drainage, cracking when dry and sticky or gummy when wet) limit the production of certain crops. They compose approximately 40% of the county's total land area (see figure 1) and are called gumbo, or buckshot, land. This group is comprised predominantly of Alligator and Sharkey soil series with a few small areas of Penjur and Tunica soil series.

4. Depressional group. These soils, not shown in figure 1, occur in each of the three previously mentioned groups. These are the low swags where excess water from the surrounding higher land accumulates. Their poor internal drainage, slow surface runoff, and low position limit the production of some row crops. They represent approximately 9% of the county's total land area. This group is comprised predominantly of the Dowling soil series with a few small areas of the Souva and Dyer soil series.

GENERAL INFORMATION ON SUNFLOWER COUNTY SOILS

Sunflower County lies in the soil province called the Mississippi River Flood Plain. All of the soils of this flood plain were derived from sediments (sands, silts, and clays) that were deposited by the Mississippi River or its tributaries. This material, called the Mississippi River alluvium, was gathered from some 20 states lying north of Sunflower County and between the Rocky and Appalachian Mountains. In other words, the soil locally called mixed land may be made up of sand from the hills of Kentucky, silt from the glacial section of Montana, and clay from the prairie sections of Iowa. These sands, silts, and clays were deposited in this area during overflows, becoming the parent material for Sunflower County soils.

The overflows occurred as follows: Before the stream overflowed, it carried material composed of sand, silt, and clay in

～	SOIL BOUNDARY, the solid line indicates the place where two different soils come together.
← →	TIE SYMBOL, connects two areas of the same soil type or phase.
—·—	SMALL NATURAL DRAIN
—··—	SHALLOW DUG DITCH
—···—	DEEP DITCH, either dug or natural.
═	WIDE PERMANENT STREAM
⁓	SMALL PERMANENT STREAM
=·=	NATURAL INTERMITTENT STREAM
Lake	LAKE
▨	INTERMITTENT LAKE
ψ	WET SPOT
'''''''''''	VERY STEEP BANK
- - - - · - - -	POWER LINE
├─┤ ├─┤	GAS LINE
━━━	PAVED ROAD
━ ━ ━	GRAVEL ROAD
— — —	IMPROVED DIRT ROAD
- - - -	FIELD ROAD
┼─┼─┼	RAILROAD
2 │ 1 11 │ 12	SECTION CORNER AND NUMBERS
— ———	COUNTY LINE
////////	CITY BOUNDARY
■	HOUSE
✝	CHURCH
⚑	SCHOOL
▬	STORE
▲	COTTON GIN
⌒	INDIAN MOUND
⊞	CEMETERY
⁙	SAND SPOT
▴	SAW MILL
- - -P/F- - -	LAND USE BOUNDARY
———	MATCH LINE
〰→	GULLY
●	FLOWING WELL

Learn the above list of symbols so that they may be recognized on the soil map.

rapid currents. As the swollen stream flowed over its banks and spread over its flood plain, the different speeds of the overflow water separated and assorted the sands, silts, and clays into the pattern in which they were depoited. Sand, being the heaviest soil fraction carried by the stream, was the first to drop out of the fast moving water, and therefore, was deposited closest to the stream. This resulted in the formation of sandy natural levees. Silt, being the second heaviest soil fraction, was deposited as the speed of the overflow water diminished. This resulted in a portion of the natural levee formations, usually the lower elevations, having silty surface textures. Clay, the smallest soil particle by size and weight, stayed in suspension longer than the sand and silt and was deposited by the overflow water as it covered the slackwater areas for long periods of time. This type of deposition resulted in clay and silty clay soils occupying the large slackwater areas of this county.

Many combinations of the above types of depositions may occur as a result of the varying speeds of the flood water. In many places it is evident that sandy natural levees have been formed by fast moving flood water and later were covered by clay sediments from very slowly moving or still water. The reverse of this is also true.

Physiography, Relief, and Drainage

Physiographically, Sunflower County is entirely located in the Mississippi River Flood Plain. Flood plain meanders, lakes, and swamps are numerous. Three rivers, the Sunflower, Quiver, and Hushpuckena, and many small bayou type streams traverse the county from north to south. Natural levees have been formed on the present and former channels of each of these streams. The sandy textured soils are usually found occupying the higher elevations of these old natural levee formations, the silty textured soils usually occupy the lower elevations of these levee formations, and the clay textured soils occupy the low elevations of the slackwater areas.

The elevation of most of the county is between 100 and 150 feet above the mean gulf level, decreasing in elevation from the north to south. The mean gulf level of Rome, which is located in the northern part of the county, is 145 feet while that of Inverness, located in the southern part of the county, is 115 feet. The elevation of Ruleville, the centrally located town of the county, is 135 feet and that of Indianola, the county seat, is 120 feet above the mean gulf level.

The relief of the county ranges from level to sloping, with the vast majority of the land being gently undulating. Escarpments, ranging from 5 to 30 feet, are often found bordering the network of streams. The difference in elevations of the top of ridges and the bottom of depressions ranges from 1 to 12 feet, with 1 to 5 feet being the most common.

The natural drainage of the county is varied with some areas having good natural drainage while others require much artificial drainage. Approximately 101 miles of the meandering Sunflower River, the most important natural drainageway of the county, is found in Sunflower County. The river enters Sunflower County near its northwest corner, flows generally southward, crosses over the county's west boundary into Bolivar County east of Merigold, meanders back into Sunflower County 5 miles south of the point from which it had left, and flows southward through the remaining length of the county. The Quiver River flows southward through portions of the northeastern and eastern part of the county, entering and leaving it many times before emptying into the Sunflower River at a point 3 miles northwest of Moorhead. The Hushpuckena River, entering the county near its northwestern corner, flows a distance of less than 3 miles before emptying into the Sunflower River.

Table 1. Approximate acreage and yields of three commonly grown crops in Sunflower County.

	1909	1929	1934	1939	1944	1949	1951
Total cropland harvested acres		328,854	316,113	314,421	315,620	309,591	----------
COTTON:							
Acres harvested	91,625	285,674	172,645	158,631	159,678	211,250	168,000
Bales	36,833	160,791	82,389	134,633	133,138	150,005	112,000
Av. bales per acre	.402	.562	.477	.848	.821	.71	.67
CORN:							
Acres harvested for grain	26,024	31,876	95,576	81,903	52,763	39,705	----------
Bushels	561,293	671,401	1,380,748	1,642,090	544,225	909,865	----------
Average bushels per acre	10.04	21.06	14.44	20.04	10.31	22.91	----------
SOYBEANS:							
Acres harvested for grain	----------	----------	----------	----------	----------	19,191	50,000
Bushels	----------	----------	----------	----------	----------	316,559	850,000
Average bushels per acre	----------	----------	----------	----------	----------	16.50	17.00

The many bayous, dragline ditches, and canals, emptying into the above three rivers, form the primary drainage system of Sunflower County. The secondary drainage system is comprised of numerous shallow dug ditches on each farm emptying into the nearest available primary drainage-way.

Vegetation

The native vegetation of Sunflower County consisted predominantly of hardwood trees with a dense undergrowth of vines and canes. Various species of oak, hickory, pecan, gum, cypress, willow, and similar trees grew.

Today, most of the county's native vegetation has been cleared with only small patches of cutover woods being found. Very few forest areas of over one square mile in size are found in the county. These areas are usually located on the nearly level slackwater and depressional soils.

Agriculture

The Indians that once occupied Sunflower County left evidence of their being good soil surveyors. The remaining Indian mounds in the county are always located on the best land of the locality. Of course, these high and well drained sandy areas were probably the only areas that were free from flooding in the days of the Indian inhabitance. Very little is known of their early agriculture. Indian corn, melons, pumpkins, and beans are believed to have been their chief crops.

The agriculture of this county has been centered around cotton since the drifting of the first white settlers to this area. Their reports that the rich Delta land produced tremendous yields by just clearing land and placing seed in soil with a minimum of cultivation spread through several southern states and brought many farmers to the Delta counties. They cleared small patches and planted cotton. Huge yields were harvested each fall, stimulating the desire to clear much larger areas for the following years. This resulted in the establishment of large plantations. Several of these original plantations are still in operation.

From the slave labor type of farming that existed before the civil war to the mechanized farming of today, cotton has been the one big money crop and all other crops were merely sidelines. Cotton seems destined to rule as "king" of all other phases of agriculture in this county for some time to come. However, today the agricultural trend is shifting towards planting cotton on the adapted soils and planting the soils not adapted to cotton production in soybeans, pastures, hay crops, and possibly rice. The fine textured and poorly drained gumbo and buckshot soils that made up our problem areas of yesteryear have good possibilities for the future in term ot green pastures, soybeans, rice fields, and large meadows of adapted hays.

Soil Survey Methods and Definitions

Soil surveying consists of the examination, classification, and mapping of soils in the field and the recording of their characteristics, particularly in regard to the growth of various crops, grasses, and trees.

The soils are examined systematically in many locations. Test pits are dug, numerous borings are made; and exposures, such as those in road or railroad cuts, gullies, ditches, pits, and other excavations are studied. Each excavation exposes a series of layers or horizons, called collectively the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied. The following characteristics are noted

1. Texture—The percent of sand, silt, and clay.
2. Color—An indication of the internal drainage.
3. Structure — The natural arrangement of the soil particles into aggregates.
4. Consistence—Refers to such conditions as friability, plasticity, stickiness, hardness, compactness, toughness, and cementation.
5. Porosity—This refers to the degree to which the soil mass is permeated with pores or cavities.
6. Permeability—This is that quality of the soil that enables it to transmit water or air.
7. Internal drainage — This is that quality of the soil that permits the downward flow of excess water through it.
8. Content of organic matter and roots.

The drainage, both internal and external, and other external features, such as the relief or lay of the land, the degree of erosion, and the interrelation of the soil and vegetation, are studied.

The soils are classified according to their characteristics, both internal and external, with special interest upon the features that influence the adaptation of the land for the growing of crop plants, grasses, and trees. Upon the basis of these characteristics, soils are grouped into classification units. The three principal units are: (1) series, (2) type, and (3) phase. In places two or more of these principal units may be in such intimate or mixed patterns that they cannot be clearly shown separately on the map and must be mapped as a complex.

A soil series is a group of soils similar in most every repect except the texture of surface layers. Therefore, a series is composed of soils with essentially the same color, structure, and other important internal characteristics, the same natural drainage conditions, and the same range in relief. The textures of the surface or plow layers may differ within a series. Alligator, Dowling, Forestdale, Dundee, and Dubbs are names of important series found in this county.

Within a soil series are one or more soil types, defined according to the texture of the surface layer of the soil. Thus, the class name of the soil texture, such as clay, silty clay, silty clay loam, silt loam, very fine sandy loam, and fine sandy loam, is added to the series to give the complete name of the soil type. For example, Alligator clay and Alligator silty clay are soil types of the Alligator series. Except for the surface textures of these two soil types, they have essentially the same internal and external characteristics.

One soil type may occur on several different slopes and may have different degrees of erosion. These differences in slope or erosion are shown by the use of soil phases. For example, Alligator clay, level (0-½% slope) phase and Alligator clay, undulating (3-7% slope) phase are two separate phases of the same soil type, Alligator clay. One can readily see that these two phases will not have the same management problems. The level phase has problems of slow surface runoff; whereas, the undulating phase has problems of accelerated surface runoff.

The soil surveyors have made a map of this county, showing the location of each of the soil types, phases, and complexes in relation to roads, houses, streams, lakes, and other local cultural and natural features of the landscape.

Know Your Soils and Plan Their Management

First Examine The Soil Map

1. Note Symbols—The first step in using this bulletin is to examine your soil-map and become familiar with the various symbols used to designate certain features found on the land (see pages 7 and 12). Every separate area of soil mapped is indicated on the map with a symbol. The first number of the symbol refers to the position and source of sediments, the second number indicates the degree of internal drainage, and the third number gives the texture of the surface layer. These first three numbers of the soil symbol indicate the soil type. These three numbers are followed by a capital letter giving the slope of the land, a number giving the degree of erosion, and another capital letter giving the present land use. For example, the soil symbol, 446B1L, is analyzed as follows:

4—The soil was derived from Mississippi River alluvium and occurs on an old natural levee formation, so-called the stratified (low terrace) position.

4—The soil is moderately well to well drained internally.

6—The surface layer is a very fine sandy loam.

B—The soil has a slope of ½-3 percent.

1—The soil is not more than slightly eroded.

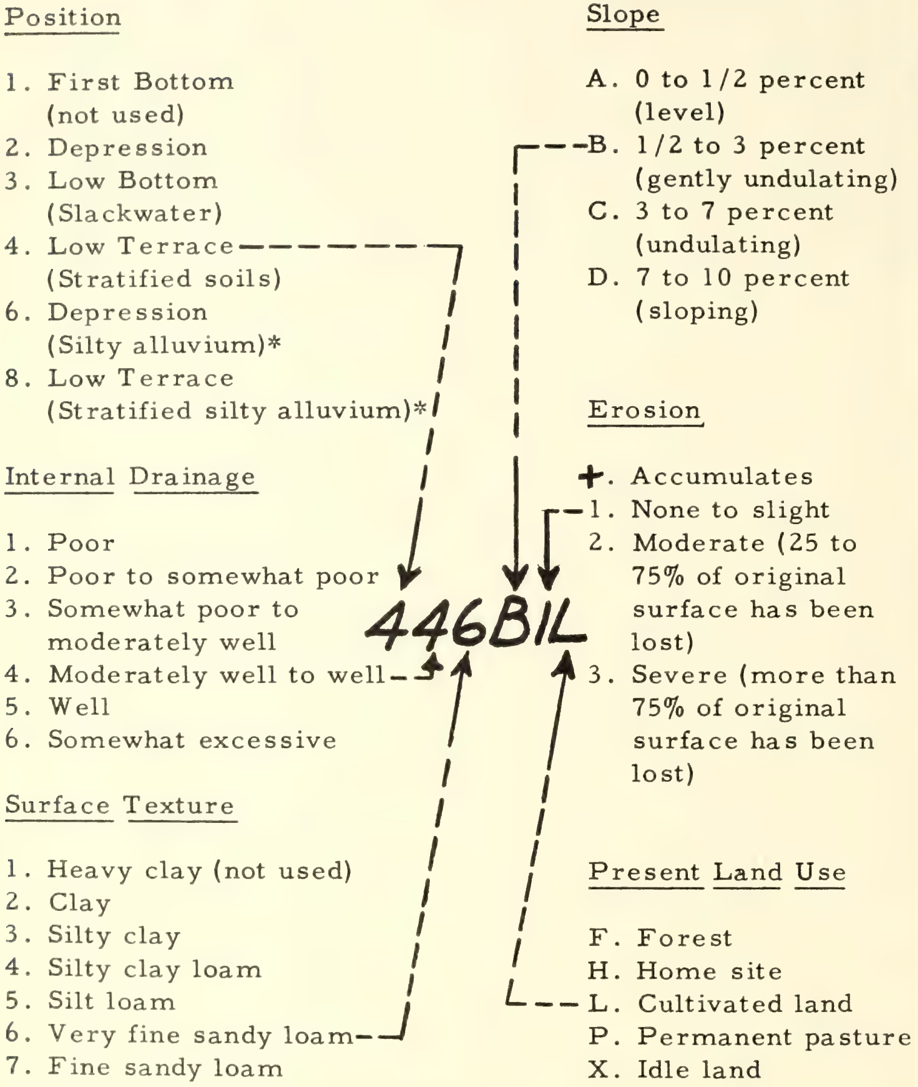
L—The soil is being used for the production of row crops.

The diagram on page 12 explains the numbers and letters found on the soil maps.

2. Entire Soil Profile Important — A soil profile is a cross-sectional view of a soil including its surface, subsoil, and parent material. In studying and classifying soils, the profile must be examined to a depth of 40 inches or more. Ofter two soils have identical surface layers, but differ widely in the subsoil, and therefore, have different land uses and agricultural values. The subsoil is a very important part of the profile and it is important that its characteristics be understood.

3. Soil Types Vary—It must be understood that the various soil types or mapping units have a range in properties. In other words, the Delta soils are not so uniform that every spot in an area mapped one particular type of soil will be identical. Boundaries between soil types vary in sharpness. Some soil types may change in a matter of a few feet and others may change over a space of 100 feet or more. Between most soil types there is a transitional zone in which the soil has properties that are common to both soil types.

In some areas the soil types occur in such a mixed up condition that separation is not practical. These areas are called complexes and are shown on the soil map by such numbers as 340, 460, etc.



Position

1. First Bottom (not used)
2. Depression
3. Low Bottom (Slackwater)
4. Low Terrace (Stratified soils)
6. Depression (Silty alluvium)*
8. Low Terrace (Stratified silty alluvium)*

Internal Drainage

1. Poor
2. Poor to somewhat poor
3. Somewhat poor to moderately well
4. Moderately well to well
5. Well
6. Somewhat excessive

Surface Texture

1. Heavy clay (not used)
2. Clay
3. Silty clay
4. Silty clay loam
5. Silt loam
6. Very fine sandy loam
7. Fine sandy loam

Slope

A. 0 to 1/2 percent (level)
B. 1/2 to 3 percent (gently undulating)
C. 3 to 7 percent (undulating)
D. 7 to 10 percent (sloping)

Erosion

+. Accumulates
1. None to slight
2. Moderate (25 to 75% of original surface has been lost)
3. Severe (more than 75% of original surface has been lost)

Present Land Use

F. Forest
H. Home site
L. Cultivated land
P. Permanent pasture
X. Idle land

*Symbol numbers of soil types occurring on these positions are preceded by the letter T when shown on the soil map.

A key to the numbering and lettering system used in surveying Sunflower County soils.

(The soil type number of a complex always ends with 0). Conditions found within these complexes are discussed on pages 36 and 37.

Compare Your Yields With Test Yields

High crop yields year after year are the results of good management. Continued low yields may be caused by poor soil, poor management, or by growing unadapted crops. Table 2 shows the crop adaptability rating for Sunflower County soils and average yields that can reasonably be expected for cotton or corn on these soils over a five-year period under good management.

Actual production records must be kept to make yield comparisons. Five-year records are necessary for good averages because of wide seasonal variations in rainfall, temperature, and insect or disease injury. Unless yearly records are maintained, the high yields are likely to be remembered and the low yields forgotten.

Practices that result in high yields of one crop, such as cotton, will not necessarily result in high yields of other crops. Some soils will produce higher yields of a specific crop than other soils. For example, the sandy soils of the Dubbs series produce more corn than the clay soils of the Alligator series. Therefore, the first step in producing high yields of any crop is to select land to which this particular crop is adapted. Since cotton is still the chief cash crop, the best-all-round land on the farm is usually planted to this crop. However, it is important that the remaining soils on the farm be planted to some adapted crop to which the soils' poor physical characteristics are not a limiting factor to good yields.

Since new crop varieties, new cultural practices, new plant disease, and new insect pests may greatly affect yield levels in the future, the figures in table 2 must be regarded as current.

Four Important Points of Soil

The following discussion of soil management is applicable to all soils in Sunflower County. Special recommendations for soil types may be found in "Soil Groups of Sunflower County, Their Use and Management," page 21.

1. **Drainage**—Good drainage is an important factor in obtaining the most efficient land use for most soils of Sunflower County. However, regardless of how much drainage has been provided, if the crop is not adapted to the soil, low yields may be expected (see table 2 for the adaptability ratings for crops on different soil

The soil map can be a good guide for locating a system of natural surface drainage for each farm. The long and usually narrow depressional areas (the soil type numbers that begin with 2, for example 210 and 212) make up the natural drainage pattern of each farm. These low swags should be used primarily for the location of drainage ditches and secondarily for the production of some adapted crop. The type and size of ditch used should be governed by the size of the watershed area and the soil types comprising the watershed area. Surface runoff from sandy soils is much less than the runoff from clay soils; therefore, the clay soil areas will require more and larger ditches for adequate drainage. Occasionally, it is necessary to cut ditches across ridges to drain isolated low areas. However, this practice should be avoided as much as possible since the absence of cross ditches results in the longer rows essential to mechanized farming.

2. **Field Layout and Row Direction**—When practical, field boundaries should be placed on soil boundaries that separate soil types requiring different treatment. Fertilizer application and other management practices suitable for the entire field can then be planned.

Where possible, roads and turnrows should be located on soil boundaries. Roads that cross soil boundaries, rather than follow them, tend to divide the field into smaller units undesirable for mech-

Table 2. Crop adaptation rating, estimated yields for cotton and corn, and the land capability class for soils of Sunflower County. (The estimated yields are those that may be expected as a five-year average with good management.)

		COTTON		CORN (hybrid)					
Soil symbol	Land class	Rating	Lbs. lint per acre	Rating	Bu. per acre	Soybeans	Pasture	Lespedeza	Small grains
435B1	I	ex	580	ex	85	ex	ex	ex	ex
T835B1	I	ex	600	ex	90	ex	ex	ex	ex
436B1	I	ex	675	ex	85	ex	ex	ex	ex
445B1	I	ex	750	ex	100	ex	ex	ex	ex
T845B1	I	ex	750	ex	100	ex	ex	ex	ex
446B1	I	ex	775	ex	100	ex	ex-vg	ex-vg	ex
456B1	I	ex	700	ex	90	ex-vg	ex-vg	ex-vg	ex
457B1	I	ex	700	ex	90	ex-vg	ex-vg	ex-vg	ex
435C1	IIe1	vg	460	vg-g	70	vg	ex-vg	vg	vg
436C1	IIe1	vg	480	vg-g	70	vg	ex-vg	vg	vg
445C1	IIe1	vg	525	vg-g	70	vg	ex-vg	vg	vg
446C1	IIe1	vg	525	vg-g	70	vg	ex-vg	vg	vg
333B1	IIs1	vg	500	f-p	50	ex	ex	ex	ex-vg
433B1	IIs1	vg	500	f-p	50	ex	ex	ex	ex-vg
434B1	IIs1	ex-vg	550	g	65	ex	ex	ex	ex
425B1	IIs2	vg-g	475	g-f	60	vg	ex-vg	vg-g	vg
T825B1	IIs2	vg	525	vg-g	70	vg	ex-vg	vg-g	vg
426B1	IIs2	vg	500	vg-g	70	vg	ex-vg	vg-g	vg
314B1	IIs3	g-f	380	p	45	ex-vg	ex-vg	ex	vg-g
324B1	IIs3	g	425	f-p	50	ex-vg	ex	ex	vg-g
424B1	IIs3	vg-g	450	f-p	50	ex-vg	ex	ex-vg	vg
460B1	IIs4	ex-g	525	ex-g	75	ex-g	ex-vg	ex-g	ex
466B1	IIs4	vg	525	g-f	60	vg-f	ex-vg	vg-f	ex-vg
467B1	IIs4	vg-f	400	g-f	60	vg-f	vg-g	g-p	vg
234A+	IIw1	g	400	g-f	55	vg	vg	vg	g
235A+	IIw1	vg	500	vg	80	ex-vg	ex-vg	ex-vg	vg
435C2	IIIe1	g-vg	420	g-vg	65	vg-g	vg	vg-g	vg
T835C2	IIIe1	g-vg	420	g-vg	65	vg-g	vg	vg-g	vg
436C2	IIIe1	g-vg	420	g-vg	65	vg-g	vg	vg-g	vg
445C2	IIIe1	g-vg	440	g-vg	65	vg-g	vg	vg-g	vg
446C2	IIIe1	g-vg	450	g-vg	65	vg-g	vg-g	g	vg
456C2	IIIe1	g	400	g	60	g	vg-g	g	vg
457C2	IIIe1	g	400	g	60	g	vg-g	g	vg
434C1	IIIe2	g	400	f	50	vg	ex-vg	vg-g	vg-g
434C2	IIIe2	g	375	f	50	vg-g	vg	vg-g	vg-g
425C1	IIIe3	g	375	f	50	vg-g	vg-g	vg-g	vg-g
425C2	IIIe3	g	375	f	50	vg-g	vg-g	vg-g	vg-g
426C1	IIIe3	g	400	f	50	vg-g	vg-g	vg-g	vg-g
426C2	IIIe3	g	375	f	50	vg-g	vg-g	vg-g	vg-g
312C1	IIIe4	g-f	300	p	30	vg	vg-g	vg	vg-g
312C2	IIIe4	g-f	300	p	30	vg	vg-g	vg	vg-g
313C1	IIIe4	g-f	300	p	30	vg	vg-g	vg	vg-g
313C2	IIIe4	g-f	300	p	30	vg	vg-g	vg	vg-g
322C1	IIIe4	g-f	300	p	30	vg	vg-g	vg	vg-g
322C2	IIIe4	g-f	300	p	30	vg	vg-g	vg	vg-g

Soil symbol	Land class	COTTON		CORN (hybrid)		Soybeans	Pasture	Lespedeza	Small grain
		Rating	Lbs. lint per acre	Rating	Bu. per acre				
323C1	IIIe4	g-f	300	p	30	vg	vg-g	vg	vg-g
323C2	IIIe4	g-f	300	p	30	vg	vg-g	vg	vg-g
423C1	IIIe4	g-f	300	p	30	vg-g	vg-g	vg	vg-g
423C2	IIIe4	g-f	300	p	30	vg-g	vg-g	vg	vg-g
424C1	IIIe4	g-f	350	p	35	vg-g	vg-g	vg	vg-g
424C2	IIIe4	g-f	350	p	35	vg-g	vg-g	vg	vg-g
340C2	IIIe4	g-f	300	p	30	vg-g	vg-g	vg-g	vg-g
460C1	IIIs1	g	425	g-f	60	vg	ex-vg	vg-g	vg
460C2	IIIs1	g	425	g-f	60	vg	ex-vg	vg	vg-g
467C2	IIIs1	g	360	f	50	f	vg-f	f	vg-g
312B1	IIIs2	g-f	350	p-f	45	ex-vg	ex-vg	ex	vg-g
313B1	IIIs2	g-f	350	p-f	45	ex-vg	ex-vg	ex	vg-g
322B1	IIIs2	g-f	350	p-f	45	ex-vg	ex-vg	ex	vg-g
323B1	IIIs2	g-f	350	p-f	45	ex-vg	ex-vg	ex	vg-g
423B1	IIIs2	g	380	f-p	45	ex	ex-vg	ex	vg-g
340B1	IIIs2	g-f	350	p-f	45	ex-vg	ex-vg	ex	vg-g
425A1	IIIw1	g-f	375	g-f	55	vg-g	ex	vg	vg
426A1	IIIw1	g-f	375	g-f	55	vg-g	ex	vg	vg
314A1	IIIw2	f	300	p	40	vg-g	ex-g	ex-vg	vg-f
324A1	IIIw2	f	300	p	40	vg-g	ex-g	ex-vg	vg-f
424A1	IIIw2	f	300	p	40	vg-g	ex-g	ex-vg	vg-f
210A	IIIw3	f-p	275	f-p	35	vg-f	vg-f	g-f	f
T624A	IIIw3	f-p	250	f-p	30	vg-f	vg-f	g-f	f
425D2	IVe1	—	—	—	—	—	g-f	—	—
435D2	IVe1	—	—	—	—	—	g-f	—	—
436D2	IVe1	—	—	—	—	—	g-f	—	—
460D2	IVe1	—	—	—	—	—	g-f	—	—
312D2	IVe2	—	—	—	—	—	g-f	—	—
322D2	IVe2	—	—	—	—	—	g-f	—	—
424D2	IVe2	—	—	—	—	—	g-f	—	—
434D2	IVe2	—	—	—	—	—	g-f	—	—
340D2	IVe2	—	—	—	—	—	g-f	—	—
312A1	IVw2	f-p	250	p	30	vg-g	ex-g	vg	vg-f
313A1	IVw2	f-p	250	p	30	vg-g	ex-g	vg	vg-f
322A1	IVw2	f-p	250	p	30	vg-g	ex-g	vg	vg-f
323A1	IVw2	f-p	250	p	30	vg-g	ex-g	vg	vg-f
423A1	IVw2	f-p	250	p	30	vg-g	ex-g	vg	vg-f
212A	IVw3	p	200	p	25	g-p	g-f	g-f	f-p
213A	IVw3	p	200	p	25	g-f	g-f	g-f	f-p

ex—Excellent: Safe and reliable land for this crop.
vg—Very Good: Reasonably safe and reliable land with only a few limitations for this crop.
g—Good: Moderately safe and reliable land with several limitations for this crop.
f—Fair: Fairly safe land, but there is always a definite risk of failure for the the crops rated "f".
p—Poor: There is a high risk of failure when planting this land to the crops rated "p".
—Not recommended.

Table 3. The nitrogen, phosphorus, and potash contained in crops, and the amounts harvested per acre.

Crop	Yield per acre*	Nitrogen	Phosphoric acid	Potash
		lb.	lb.	lb.
Cotton lint	500 lbs.	------	----	2.5
Cotton seed	900 lbs.	35	15	12.5
Corn grain	75 bushels	72	42	21
Corn stover	5000 lbs.	48	15	24
Oat grain	30 bushels	21	8	6
Oat straw	1500 lbs.	9	4	27
Soybean seed	30 bushels	132	32	40
Soybean hay	2 tons	100	24	60
Lespdeza hay	2 tons	87	20	47
Alfalfa hay	2 tons	93	25	107
Tomatoes (fruit)	6 tons	36	12	48
Cabbage	15 tons	100	50	100

*Should your yields differ from the above figures, the nitrogen, phosphorus, and potash content will vary proportionately to your yields.

anized farming. The boundaries of soils on C (3-7%) and D (7-10%) slopes, as well as escarpments and stream banks, are ideal locations for roads.

Row direction is important and should be governed by the soil type, slope of the land, and method of tillage. Soils on level topography require row direction that allows the best possible runoff. On poorly to somewhat poorly drained soils the row direction should be such that each row will carry the excess water to an outlet. Of course, this should not be done when there is danger of erosion. The somewhat poorly to somewhat excessively drained soils (soil type numbers where the middle digit is 3, 4, 5, or 6) should have rows running on the contour in order to conserve moisture and prevent excessive erosion. Generally, this means the rows should parallel the natural low swags, natural streams, bayous, and ridges.

The above suggestions usually make it possible to lay out permanent fields with larger areas and longer rows. These long rows over uniform soil tend to make mechanized farming more efficient.

3. Fertilization—Fertilizer is very important in Sunflower County to obtain maximum yields from crops; however, the number of fertilizer elements needed for the majority of the soils of this county is much smaller than in the upland counties of Mississippi.

Nitrogen has long been recognized as the most lacking fertilizer element in Sunflower County soils. Addition of nitrogen and organic matter to the soil increases the productivity for non-legume crops. The incorporation of organic matter in soils with undesirable physical characteristics always results in easier tillage and higher yields. Properly inoculated legume crops and manure provide a good source of both nitrogen and organic matter. Crop residues plowed under are also important in keeping the soil in a good, mellow condition and in increasing the rate at which it will absorb water. Vetch and bur clover are well adapted to the silty and sandy soils (soil types with numbers ending in 5, 6, or 7). Vetch and winter peas are both adapted to soils with high clay content (soil types with numbers ending in 2, 3, or 4). However, growing of winter legumes on clay soils to be turned under in the spring is very hazardous. The shallow surface layers of these soils make it very difficult to cover a rank growth of winter legumes well enough for rapid decomposition. Usually, most of these fine textured soils are broken in the fall so that it is not necessary to disturb the seed bed in the spring. Spring breaking of these soils usually leaves them in a cloddy condition throughout most of the growing season. For these clay soils, a rotation where summer legumes, such as soybeans, are grown for nitrogen and organic matter, is sometimes desirable. Where it is not practical to grow leguminous crops, a commercial nitrogenous fertilizer must be used on all non-legume crops if maximum yields are to be obtained. Depressional areas, where water accumulates from higher surrounding land, maintain a higher nitrogen level and do not require additions of large amounts of commercial nitrogen. In fields where numerous small depressions occur more efficient use of nitrogenous fertilizer can be obtained by leaving the fertilizer off of the rows that are located in the depressions and applying more to the rows on the ridges.

Most of the soils of Sunflower County are acid, or sour. Many crops are acid tolerant—for example, cotton and corn. Clovers and most other legumes grow best on soils that have only a slightly acid, neutral or slightly alkaline reaction. (Soils with these reactions are usually referred to as being sweet). Soils that are acid, or sour, should receive applications of lime until the reaction reaches the above mentioned sweet condition, if any of the legume crops are to be grown. Where rotations include legumes for nitrogen an application of lime will usually result in a better growth of inoculated legumes. This in turn, furnishes more nitrogen and organic matter to the soil for the production of the non-legume crops. The amount of lime necessary to bring the reaction up to the desired level for the best growth of legumes depends principally on two factors: (1) sourness and (2) texture of the top soil. Soils with high clay content in the top soil will require much larger applications of lime to bring them to the desired reaction level than sandy soils with the same degree of sourness.

Experimental work with phosphorus (phosphate) and potassium (potash) fertilizers on most Delta soils has shown little need for these minerals. This does not mean that there are no areas in the county deficient of these minerals. This, also, does not mean that in years to come Delta soils will not be depleted of their phosphate and potash supply. The sediments from which the soils of Sunflower County were formed were rich in these minerals, and the past continuous cotton type farming has removed little of these elements. If a change should occur in the type of agriculture in which more hay and grain crops would be grown, these elements would be removed from the soil much faster. These deficiencies would first show up in the soils of the stratified (low terrace) group, and it is on these soils that the farmer should watch for deficiency symptons and reduced yields in his crops. In many cases reduced yields are caused by the poor physical condition of the soil. This condition must be corrected before crops can efficiently use the available fertilizer.

Proper soil analysis can serve as a very good indicator of soil fertility. Therefore, when farmers think that their soils may be low in phosphorus or potassium, or if they decide to lime their land and want to know the approximate amount to apply per acre, they should have their soil tested in the quick-test laboratory at State College, Mississippi, and use this information for further studies in the field. If the test shows an existing deficiency in phosphorus or potassium and the yields have been declining over a period of years, the farmer should then apply the recommended fertilizer treatment on 10 to 15 rows in the field or a small plot, if in a pasture. It is important that 10 to 15 rows next to the treated rows be left as a check. Do not apply phosphorus or potassium to these rows. After comparing the results between the treated and untreated plots, the farmer is then in position to decide whether or not

Table 4. A guide to Delta pasture and feed crop production.

Pasture plant	Recommended varieties	Rate of seeding per acre	Fertilizer	Type of soil preferred	Time of planting	Approximate grazing season
Alfalfa	Buffalo Kan. Common Okla. Common	20 lbs.	Test soil	Well drained	Oct. 1-15	3 to 5 cuttings of hay
Dallis grass	Imported	15 lbs.	30 lbs. N. when planted 30 lbs. N. Sept. 1	Mixed or heavy clays	Mar.-Apr.	May-Nov.
Fescue alone	Kentucky 31 Alta	10 lbs. 8 " drill	4 app. 60 lbs. N. Sept., Nov., Mar. & May	Heavy clays	Sept. 1-Nov. 1	Oct. 15-July 1
Fescue with Ladino	Kentucky 31 Alta	10 lbs. 8 " drill 5 lbs. in rows	30 lbs. N. when planted 60 lbs. N Oct.	Heavy clays	Fescue: 9/1-11/1 Ladino: 10/1-11/15	Oct. 15-July 1
Red clover	Kenland Cumberland	15 lbs	Test soil	Mixed or heavy clays	October	Mar. 1-Aug. 1 or 2 hay cuttings
Ladino clover	------------	1 lb. broadcast	Test soil	Heavy clays	Oct. 1-Nov. 15	Oct. 15-July 1
White Dutch or La. Giant clover	------------	2-4 lbs.	Test soil	Heavy clays	Oct. 1-Nov. 15	Mar. 1-July 1
Sudan	Tift or Sweet	10 lbs. in 40" rows 30 lbs. broadcast	60 lbs. N. 90 lbs. N.	Sandy loams or mixed	June 1-July 1	**July-Oct.**
Millet	Pearl Starr	10 lbs. in 40" rows 30 lbs. broadcast	60 lbs. N. 90 lbs. N.	Sandy loams or mixed	June 1-July 1	July-Oct.
Lespedeza	Korean Kobe	30-50 lbs. 25-35 lbs.	------------	Sandy loams or med. heavy clays	Late Feb.-Mar.	June-Oct
Grain sorghum	Martin	8 lbs. in 40" rows	30 lbs. N.	Sandy loams or heavy clays	June	Hog off Aug., Sept., or Oct.
Oats	Delta Red-Late Nortex-Late Delair-Early	2 1/2 to 3 bu.	60 lbs. N. Sept. for grazing; 30-40 lbs. N. Feb. for grain	Sandy loams or med.	Sept. 1-Nov. 1	Nov. 1-Mar. 1
Ryegrass	Domestic	25-30 lbs.	30 lbs. N. in fall 40 lbs. N. in Mar.	All types	Sept. & Oct.	Dec.-May
Winter peas	------------	50 lbs	Test soil	Heavy clays	Sept. & Oct.	Feb.-May 15
Johnson grass	Volunteer	------------	40 lbs. N. April	All types	------------	Alternate grazing Apr.-Nov.
Wheat	Chancellor Atlas 66	1 1/4	**Same as oats**	------------	------------	

Table 5. Guide to season and rate of production of pasture crops recommended for the Mississippi Delta.

Month	Ladino Fescue	Ryegrass White clover Bermuda	Dallis Lespedeza	Red clover Johnson grass	Red clover Oats	Red clover Ryegrass	Lespedeza Johnson grass	Oats Grazing	Oats (grain) Lespedeza	Wheat Grazing	Millet Pearl, Star	Sudan grass	Winter peas	Johnson grass	Ryegrass Crimson clover
March	2*	1 1/2	--------	1	2	2	--------	1	......	1	--------	--------	2	--------	2
April	2 1/2	1 1/2	1/2	2	2	2 1/2	--------	2	.	2	--------	--------	2	--------	3
May	2	1 1/2	1	2	2	2	1	1 1/2	--------	1	--------	--------	--------	--------	1
June	1 1/2	1	1 1/2	1 1/2	1	1	1	--------	--------	--------	--------	--------	--------	1	--------
July	--------	1	1	1	1	1	1 1/2	--------	1 1/2	--------	1	1	--------	1	--------
August	--------	1/2	1	1	--------	--------	1 1/2	. ..	1 1/2	--------	3	3	--------	1	--------
September	--------	1/2	1	1	--------	--------	1	--------	1	--------	2	2	--------	1	--------
October	1/2	1/2	1	--------	--------	--------	1/2		-- - --	--------	--------	--------	--------	1	--------
November	1 1/2	--------	1/2	--------	1/2	--------	--------	1 1/2	------	1	--------	--------	--------	--------	--------
December	1	--------	--------	--------	1/2	--------	--------	1 1/2	--- --	1 1/2	--------	--------	--------	--------	1
January	--------	1/2	--------	--------	--------	1/2	--------	.	--------	1/2	--------	--------	--------	--------	1/2
February	1/2	1	--------	--------	1	1	--------	--------	--------	1/2	--------	--------	1	--------	1/2

*The approximate number of animal units the pasture will carry on the average per month.

he should use phosphorus and potassium fertilizers. Consult some of the agricultural workers in the county regarding how to collect your samples for soil analysis.

The following fertilizer recommendations, pasture recommendation (table 4), and season and rate of production of pasture crops (table 5) were made by the Delta Branch Experiment Station, Stoneville, Mississippi:

Cotton

1. Apply 60-75 pounds of nitrogen per acre to the silt loams and sandy loams (soil type numbers ending in 5, 6, or 7) and 90-100 pounds of nitrogen to clays, silty clays, and silty clay loams (soil type numbers ending in 2, 3, or 4).
2. Where a good growth of winter legumes is turned under, little or no additional nitrogen is needed. If poor stands or a poor growth prevails, commercial nitrogen should be applied accordingly.
3. Apply nitrogen prior to planting or as an early sidedressing.
4. If nitrogen is to be applied as a sidedressing, make application immediately after the cotton is cleaned out for the first time.
5. Apply anhydrous ammonia 6 to 8 inches deep on sandy loam soils and 5 to 6 inches deep or as deep as conditions will permit on gumbo or buckshot soils. The anhydrous ammonia must be sealed in the soil. Apply solid materials as deep as practical with available equipment.
6. Apply phosphate and potash on a trial basis only, except where beneficial results have been established. Have soils analyzed to indicate need for trials.

Corn

1. Apply 120 pounds of nitrogen per acre.
2. Place nitrogen as deep as practical with available equipment. (A depth of at least 6" is desirable.)
3. Apply nitrogen prior to planting or as an early side dressing—applying nitrogen before planting will save at least one cultivation.
4. Leave approximately 12,000 corn plants per acre. If corn is planted in checks, leave three stalks per hill; or, if corn is drilled, leave corn spaced about 13 to 15 inches apart.

Soybeans

Use no fertilizer except on a trial basis or where beneficial effect has been established.

4. Irrigation — Several farmers have tried irrigation on their pastures during the two preceding dry years with varied results. Irrigation of row crops is in the experimental stage with good possibilities for the future. Rice irrigation has been successful .

With the type of irrigation required for rice production, the subsoil is an important factor. There must be a subsoil layer in the soils planted to rice which will retard or prevent the downward movement of water. The Alligator and Sharkey soils are ideal for this type of irrigation. It also can be practiced on the Forestdale and Tunica soils without serious loss of water.

Most all of the soils of Sunflower County, with the exception of the soils that occur on steep slopes, may be irrigated for pasture and row crop production. Should you plan to irrigate pastures and row crops, keep the following two points in mind.

1. Irrigate the crops as they need it. Once the ground is badly cracked it is difficult and costly to seal these cracks, and the plants' root systems have already been damaged. Often row crops start a second growth after irrigation when it has been delayed for a long period of time. This second growth usually reduces the yields of these crops.
2. Use a system of irrigation where several inches of water can be applied in a fairly short period of time so that it will be comparable to a normal, good rain. Irrigating with only small amounts

of water usually gives no beneficial results.

Regardless of the crop you plan to irrigate, be sure to have an abundant source of water before making definite plans for irrigation. When several farmers are irrigating large areas with water from the same lake or small stream, the water supply is sometimes exhausted during dry seasons.

Know The Specific Problems Of Your Soils

Study your soil map and identify all of the different types of soil that occur on your farm. After the different types have been identified, study their descriptions in this bulletin and their crop adaptability ratings in table 2.

Most farms have soils that vary widely in adaptability to different crops. Some of the soils may be excellent pasture land, but a poor risk for cotton production. By using the soil map as a guide, the soils adapted to similar crops and requiring similar management practices may be blocked off and put to the same land use.

Each soil condition has problems that may or may not be general in all of your soils. All may have the same surface texture; but the internal drainage could vary from poor to excellent. This variability can affect crop adaptation. On the other hand, the internal drainage may be the same on all of your soils, but surface textures may vary widely. These variations can affect the choice of crops and methods of tillage.

Slopes of the different soils may cause problems in row directions, field boundaries, and surface drainage. The stronger slopes present erosion problems, whereas the almost flat slopes present problem of adequate surface drainage.

Many fields in Sunflower County have two or more soils with widely varying characteristics that require different types of crops and management. When the area of one soil is very small it is often necessary to farm it the same as the surrounding type or types. Otherwise, each soil type can be managed separately and put to its best land use.

Soil Groups of Sunflower County—Their Use and Management

The soils of Sunflower County have been grouped into land-capability classes, based on the ability of the soil to produce permanently under specified use and treatment. Each land-capability class consists of soils that are essentially uniform with respect to crops or other plants that can be grown. The soils in this county have been grouped according to the system employed by the Soil Conservation Service, using eight land-capability classes for all the land in the United States. We have only the four following classes in this county:

Class I. Safe and reliable land that can be cultivated with ordinary farming methods.

Class II. Comparatively safe and reliable land that can be cultivated safely with easily applied practices.

Class III. Fairly safe and reliable land that can be cultivated safely when intensive practices (such as control of erosion, conservation of moisture, or construction of adequate surface drainage) have been applied.

Class IV. Land not suitable for continuous cultivation, but which may be occasionally cultivated with careful management.

Within each of the above classes of soils except Class I, there are sub-classes and land-capability units, based on the dominant hazard involved and on the treatment necessary. The principal hazards are erosion, indicated by the letter e; excess water, indicated by the letter w; and some special soil conditions, indicated by the letter s. Except for Class I land, all of the soils in this county have one or more of the above hazards. For example, Class IIe indicates that erosion is the main hazard in this group. Because of differences in physical characteristics all of the soils with erosion hazards cannot be grouped together. Some must be treated differently. Therefore, land-capability units, which are groups of soil types and phases that require the same treatment, have been established. These land-capability units are indicated by numbers following the letter that indicates the dominant hazard. For example, Class IIel and IIe2 have the same capability and the same dominant hazard, but require different treatments. Class IIsl has the same capability as those previously mentioned, but has a different hazard or condition within the soil that requires special treatment.

Following is a description of the Land Classes and the suggested treatments:

Class I. These soils are deep, stratified, moderately well to well drained, gently undulating (½-3% slope), productive silt loams and sandy loams that, with good management practices, may be expected to produce medium to high yields continuously. This is excellent land for most row crops, hay crops, and grasses adapted in Sunflower County (see table 2). It may be cropped annually, followed by winter legumes. These soils work easily, but rain causes them to crust when bare. The characteristics of the subsoil allow good movement of water and air through it as well as fairly deep root penetration. This group of soils is found on the old natural levee formations and occupies higher elevations than the surrounding soils. Good internal drainage, high elevation, and medium textured surface make this land very desirable for winter grazing. Row direction should be on the contour. Little artificial drainage is needed since the subsoil is fairly open or porous.

This group is comprised of the following soils: 435Bl, 436Bl, 445Bl, 446Bl, T835Bl, T845Bl, 456Bl, and 457Bl.

Class IIel. The undulating (3-7% slope), uneroded phases of the above soil types compose this group. These stronger slopes present possible erosion problems and necessitate the application of good management practices before safe cultivation can be performed. This land is well adapted to the locally grown grasses and crops, with the exception of rice (see table 2). All tillage operations should be on the contour to prevent erosion, and conserve moisture. A rotation that includes close growing or sod crops for two out of four years is suggested if the area is large enough to merit separation from the surrounding fields. Most grass and gume mixtures of this county grow well on this land and it is especially well adapted to winter grazing. No artificial drainage is necessary.

This group is comprised of the following soils: 435Cl, 436Cl, 445Cl, and 446Cl.

Class IIsl. These are somewhat poorly to moderately well drained, deep stratified, gently undulating (½-3% slope), productive soils. They differ from the soils of Class I in that they have a rather fine textured surface, or plow layers. This land is very good for most row crops and excellent for most grass and hay crops of this area (see table 2). Row direction should usually follow the contour. Most grass and legume mixtures of this area grow well on this land. It is well suited for sericea, alfalfa, and other deep rooted perennials.

This group is comprised of the following soils: 333Bl, 433Bl, and 434Bl.

Class IIs2. These are deep, stratified, cold natured, somewhat poorly to poorly drained, gently undulating (½-3% slope) soils with silt loam and very fine sandy loam surfaces. These soils are less fertile than the above group and are limited in productivity by somewhat poor to poor internal drainage. The high silt and clay content of the subsoil retards the downward movement of water. Row direction should be such that excess water can be removed. This is very good to good land for most row crops, hay crops, and pasture grasses (see table 2). Non-legume crops should sometimes be followed by winter legumes, and it is suggested that a rotation be used which includes a summer legume at least every third year in order to maintain the fertility level and improve the physical conditions of the soil. Some artificial drainage is usually needed. Irrigation can be practiced on this land without serious loss of water.

This group is comprised of the following soils: 425B1, 426B1, and T825B1.

Class IIs3. These are deep, somewhat poorly to poorly drained, gently undulating (½-3% slope) soils with fairly fine surface textures and tough subsoils. This land ranges from excellent to fair for row crops, but is excellent to very good for most hay crops and grasses adapted to the county (see table 2). The fine textured (high clay content) subsoil is responsible for the very slow movement of water downward and limits the productivity of these soils. When used for non-legume row crops, it is suggested that a rotation be used that includes summer legumes for two out of every four years. These close growing or sod crops are necessary to help maintain the fertility level and to improve the physical conditions of the subsoil. Row direction should be such that excess water is carried to adequate outlets. This land is well adapted to fescue and white clover, Dallis grass and lespedeza, or Johnson grass and red clover. Irrigation can be practiced on this type of land with little loss of water. Artificial drainage is needed when production of row crops is attempted.

This group is comprised of the following soils: 314B1 324B1, and 424B1.

Class IIs4. These are deep, stratified, somewhat excessively drained, gently undulating (½-3% slope) soils that are well adapted to early truck crops, early maturing corn, small grains, and winter grazing crops. Many row crops and some hay and grass plants grow well during wet years, but usually suffer for moisture during dry years. When used for row crops, it is suggested that a rotation be used that will include sod crops for two out of every four years in order that the organic matter may be increased and the fertility level maintained. Winter legumes should always follow non-legume row crops. Frequent fertilization is necessary to produce grazing over long periods. the porous subsoil allows rapid movement of water downward, which permits rapid leaching of the applied minerals. Row direction should follow the contour to conserve moisture.

This group is comprised of the following soils: 460B1, 466B1, and 467B1.

Class IIw1. These are somewhat poorly drained, productive, depressional soils where excess surface water from adjacent higher land tends to accumulate after each large rain. This land is fairly well adapted to most locally grown row crops and is well adapted to most hay crops and grasses when proper artificial surface drainage has been provided. Fescue and white clovers, Dallis grass and lespedeza, and summer annuals for temporary grazing thrive on this land.

This group is comprised of the following soils: 234A+ and 235A+.

Class IIIe1. This group of soils is similar to the soils of Class IIe1, differing from them by being moderately eroded (25 to 75 percent of the original surface layer has been lost to erosion). When these areas are large enough in size to merit fencing, permanent pasture sods are a good land use. All land preparation for row crops should be done in the spring on the contour. Row crops should be followed by winter legumes. This land is adapted to kudzu and sericea plants. Because of good surface runoff, good internal drainage and medium surface textures, this land is well adapted to winter grazing.

This group is comprised of the following soils: 435C2, 436C2, 445C2, 446C2, 456C2, 457C2, and T835C2.

Class IIIe2. These soils are the undulating (3-7% slope) phases of the soil types of Class IIs1. The stronger slopes present erosion problems and necessitate the application of special practices before safe cultivation can be carried out. Row direction on the contour is necessary and it is suggested that rotations be used that include row crops for one year and sod or close-growing crops for two years. This land is well adapted to deep-rooted perennials, such as sericea and alfalfa. The soils of this group are well suited to winter grazing.

This group is comprised of the following soils: 434C1 and 434C2.

Class IIIe3. These soils are similar to the soils of Class IIs2, differing from them by occurring on steeper slopes (3-7%). Contour tillage and rotations which include close-growing or sod crops are suggested to prevent the hazards of erosion. Row crops should be followed by winter legumes. This land is adapted to most locally grown pasture combinations and it is especially well adapted to winter grazing. For crop ratings see table 2.

This group is comprised of the following soils: 425C1, 425C2, 426C1, and 426C2.

Class IIIe4. This group of soils includes all of the poorly drained, fine-textured soil types that occur on undulating (3-7% slope) topography. Some of these soils are moderately eroded. Row direction should be on the contour, and it is suggested that rotations be used which include two years of close-growing or sod crops to one year of row crops. Practically the same plants, with the exception of rice, are adapted to these soils as are adapted to the soils of Class IIIs2. For crop ratings see table 2.

This group is comprised of the following soils: 312C1, 312C2, 313C1, 313C2, 322C1, 322C2, 323C1, 323C2, 340C2, 423C1, 423C2, 424C1, and 424C2.

Class IIIs1. These soils are similar to the soils of Class IIs3, differing from them by occupying steeper slopes (3-7%) and by being more subject to the hazards of erosion. Both groups are adapted to the same crops. Some of the soils of this group are moderately eroded. Contour tillage should be used to conserve moisture and prevent erosion. Frequent applications of fertilizer are necessary to produce highest yields as the porous subsoil allows rapid movement of water downward, causing rapid leaching of the applied minerals.

This group is comprised of the following soils: 460C1, 460C2, and 467C2.

Class IIIs2. These are deep, poorly drained, gently undulating (½-3% slope), slackwater soils with fine textures (high clay content) in both the surface and subsoil. This land is well adapted to rice, hay crops, grasses, and soybeans, but is poorly adapted to some row crops (see table 2). The fine textured subsoils cause the downward movement of water to be very slow. Extensive drainage systems are necessary to take care of excess surface water. The tillage of these soils is difficult, since their characteristics cause them to be plastic when wet and very hard with numerous cracks when dry. Best results are generally obtained when the soils of this group are plowed in the fall. Growing winter legumes for green manure on these soils is hazardous since this practice requires the preparation of the seed bed in the spring. When this land is used for cotton, a rotation should be used which includes sod crops or a summer legume two out of every four years in order that the fertility level may be maintained and the physical conditions of the soil may be improved. Most pasture combinations of this area grow well on this land. Row direction should be such that each row will carry the excess water to adequate outlets.

This group is comprised of the following soils: 312B1, 313B1, 322B1, 323B1, 340B1, and 423B1.

Class IIIw1. These soils are similar to the soils found in Class IIs2, but differ from them bv occurring on level slopes (0-½%) and by always needing some artificial surface drainage. This land is excellent for most pasture plants, good for some row crops, and only fair for others. Soybeans, lespedeza, fescue and white clover, and summer crops for temporary grazing are some of the best uses for this land. Rice is well adapted to these areas, but is seldom planted on these soils because of their small acreage.

This group is comprised of the following soils: 425A1 and 426A1.

Class IIIw2. These soils are similar to the soils found in Class IIs3, but differ from them by occupying level slopes (0-½%). Artificial surface drainage is always needed. This land is best adapted to grasses, rice, and hay crops. Cotton and corn are not too well adapted to these soils (see table 2).

This group is comprised of the following soils: 314A1, 324A1, and 424A1.

Class IIIw3. These are poorly drained to depressional soils where excess surface water from adjacent higher soils tends to accumulate after each large rain. The level topography and clay subsoil through which water moves very slowly always necessitates artificial surface drainage before these soils can be utilized for field crops. With proper drainage this land is adapted to the growing of soybeans, hay crops, silage crops, and summer temporary grazing crops. Cotton and corn production involve a certain amount of risk on these soils. Most pasture mixtures of this locality are adapted to this land. The small acreage that a delineation of one of these soils occupies often makes it impractical to separate it from the adjoining fields and put it to a different land use. Therefore, in many instances these depressed areas are farmed the same as the surrounding fields. These low swags are part of the natural drainage pattern of the area in which they occur and should be used primarily for the location of drainage ditches and secondarily for crop production.

This group is comprised of the following soils: 210A+ and T624A+.

Class IVe1. These are infrequently found, sloping (7-10%) moderately eroded silt loam and very fine sandy loam soils that occur on short, steep slopes along the channel of some present or former stream. Row crops are not recommended, as these soils erode rapidly when bare. Permanent sod or deep-rooted perennials are suggested because of the strong slopes.

This group is comprised of the following soils: 425D2, 435D2, 436D2, and 460D2.

Class IVe2. These are infrequently found, sloping (7-10%), moderately eroded, clayey textured soils that are located on short, steep slopes along the channel of some present or former stream. Row crops are not recommended and permanent pasture sods or forest are the suggested land uses.

This group is comprised of the following soils: 312D2, 322D2, 340D2, 424D2, and 434D2.

Class IVw2. These soils are similar in physical characteristics to the soils found in Class IIIs2, but differ from them in occupying level relief (0-½% slope). Extensive artificial drainage systems must be established before these soils can be used for row crop production. This land is well adapted to locally grown pasture mixtures (such as fescue and white clover or Dallisgrass and lesdedeza) and to forest. Many of the newly established rice farms are located on these soils with very good yields being obtained.

This group is comprised of the following soils: 312A1, 313A1, 322A1, 323A1, and 423A1.

Class IVw3. These are poorly drained, depressional soils where excess surface water from adjacent higher soils tends to accumulate after each large rain. These soils have fine textures (high clay content) in the surface and subsoil layers. This clay in the subsoil, which greatly retards the downward movement of water, and their depressed location always make artificial surface drainage necessary. However, the location of these soils in the natural low swags or depressions makes them invaluable as guides for locating secondary and primary drainage ditches and canals. These areas are a part of the natural drainage pattern of the area and should be used primarily for the location of drainage ditches and secondarily for the production of crops, grasses, or trees. Rice, fescue, white clover, Dallisgrass and lespedeza, summer temporary grazing crops, and forest are the best land uses. Cotton and corn are poorly adapted crops to these soils.

This group is comprised of the following soils: 212A+ and 213A+.

The Value of a Soil Map in Preparing a Farm Plan and Operating a Farm

Every farmer has a special interest in the land that he is farming. Those that have farmed the same land for many years know the different kinds of soil that make up their farms. It is important that they know the main good and bad points about all of their land. No doubt most farmers easily recognize sandy land and gumbo land. However, it is more difficult to recognize the many subdivisions of each of these two broad classes of land.

A soil map is the farmer's inventory of his land in terms of soils, their characteristics and capabilities. Also, the soil map can be used as a guide for locating drainage ditches, turnrows, and field roads; laying out permanent field boundaries; and determining proper row directions. To plan the best land use for each type of soil, without the aid of a good soil map, takes a lots of studying, and in some cases, costly experience. Even for the farmer who knows the capabilities of each piece of land on his farm, the soil map will help to explain some of the things that he has observed from year to year.

The following part of the bulletin is written for the farmer who is interested in studying his soil map and formulating and developing a logical and profitable farm plan for his farm.

To illustrate the use of soil maps in farm planning, a 250-acre farm has been selected (see fig. 3). The soils of this farm range from low, poorly drained clays to high, moderately well-drained silt loams. Approximately 189 acres of this poorly drained and fine textured land is poorly adapted to cotton of corn, and continuous planting of these two crops on this land involves a rather high risk. This same land is well adapted to many pasture plants and hay crops. Approximately 37 acres of this land, the high and well drained loams, are well adapted to cotton, corn, and soybeans. In the past years, most all of the land on this farm has been planted in cotton with only occassional good yields being obtained on the clays and good yields being obtained on the loam soils.

It is realized that many different uses could be made of the soils on this farm, and the likes and dislikes of the farmer must be considered. However, it is believed that a combination livestock and cotton program would be one of the most successful enterprises of this land.

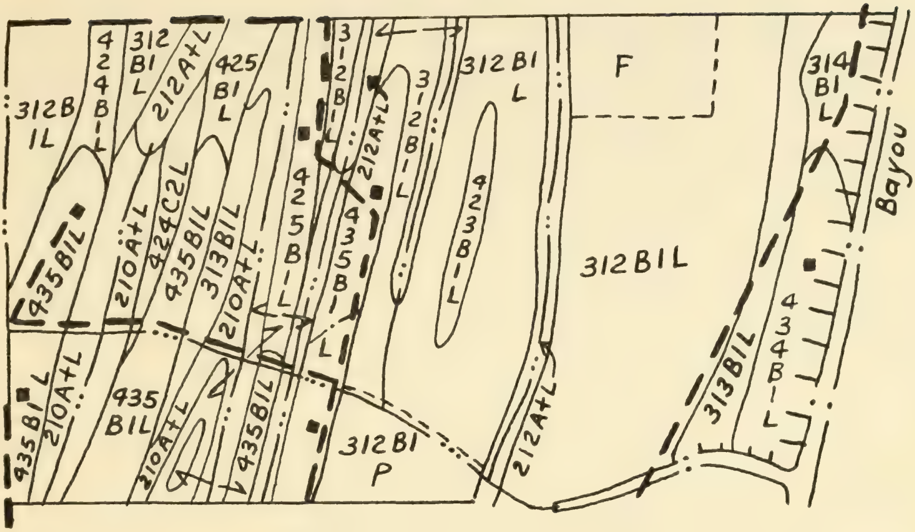


Figure 3. Soil map of 250-acre farm.

In this county the first consideration in developing a good farm plan is that of farm drainage. Farm drainage consists of two parts — secondary drainage and primary drainage. By examining the eastern half of the soil map of this farm, it is observed that the soil types 312 and 313 predominate. The middle digit of these numbers indicates poor internal drainage, and the last digits indicate clay and silty clay textures. These two soil conditions mean that most of the surface water of this watershed will have to be carried off by good ditches. The narrow low swags (212), running north and south through this watershed, form the natural drainage pattern of the area. A good size ditch in the center of each of these low areas, emptying into the outlet of the bayou, will adequately drain this portion of the farm. By examining the western part of the soil map, ridges (soil numbers beginning with 4) and depressions (soil numbers beginning with 2) are observed. The soil numbers 435 and 425 predominate the ridges and 210 predominates among the depressional soils. The middle digits 3 and 2 of the ridge soils indicate internal drainage that ranges from moderately well to poor. The last digits of the numbers indicate silt loam surface textures for the ridge soils. These two characteristics mean that there will be some surface runoff in this watershed, but not so much as on the eastern side or watershed of the farm. The depressions, being naturally low, are the areas where the excess water accumulates. Small ditches located in the center of these depressions and emptying into a primary drainage channel will adequately drain this watershed. One deeply dug drag line ditch has been located so as to cut across each of the isolated land-locked depressions, carrying the water to the deep bayou. This primary drainage is adequate. However, had the large ditch been located on the northern boundary of the ridge and depressional area, it would be possible to have longer rows paralleling the low swags and ridges which would be more desirable for mechanized farming. It will be noted that most all of the ditches necessary to drain this farm have already been constructed.

Figure 4 shows the proposed drainage, turnrow location, and tenant house locations for this farm. Soil boundaries, pro-

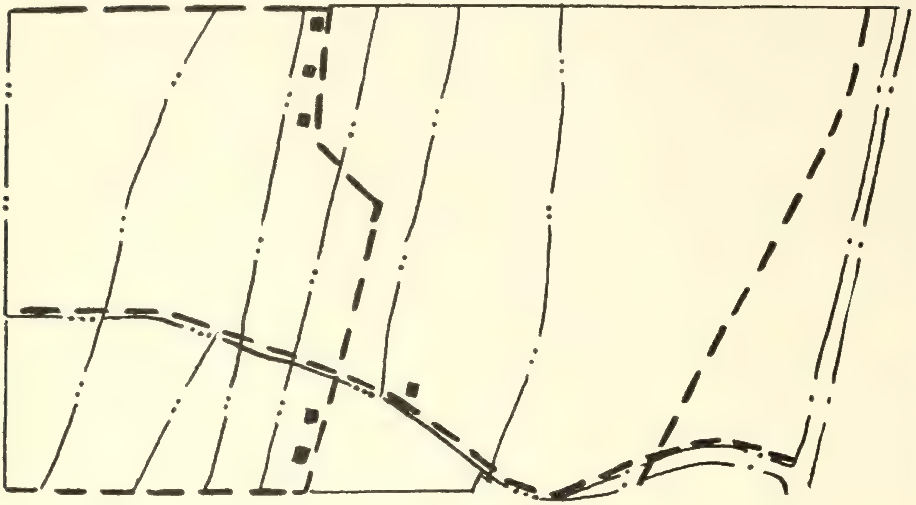


Figure 4. Farm drainage map of farm with road and house location.

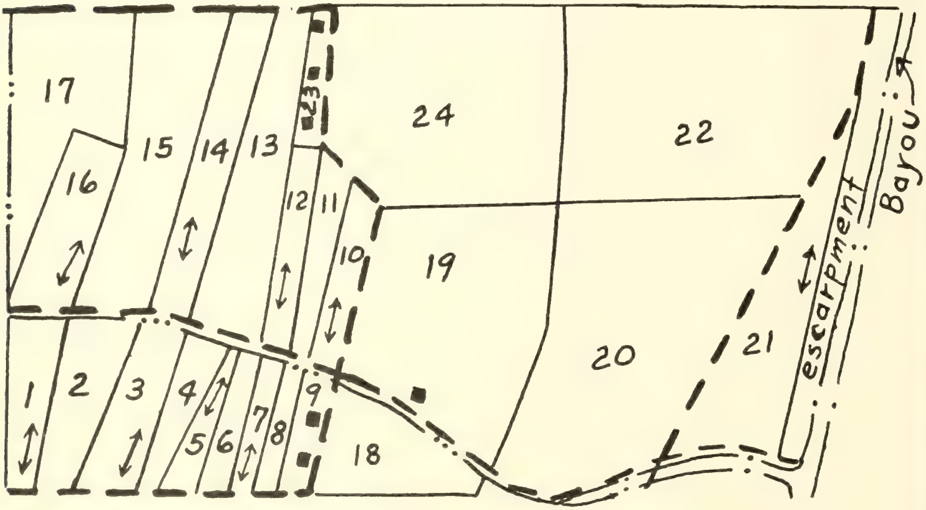


Figure 5. Map of 250-acre farm with permanent field boundaries and row direction indicated.

perty boundaries, large ditch banks, and stream banks make excellent locations for roads. Any old houses that are not intended for use as tenant houses should be moved near or inside the pastures for the storage of hay. It is suggested that the other tenant houses be moved from the center of fields and grouped on main roads. Roads to houses in the middle of fields interfere with size of fields and length of rows. When houses are grouped, farm labor can be quickly contacted, electricity and natural gas can be brought to one general area, and a conveniently

Field	Acres	1954	1955	1956	1957	Seeding Recommendation	Fertilizer Recommendation
1 3 7 10 14	4 6 2.2 4 7	Cotton, followed by vetch	Continue	Continue	Continue	Cotton—1 bu. per ac. Vetch—30 lbs. in September	Good growth of vetch plus 30 pounds of nitrogen
5 12	3 4.5	Cotton, followed by vetch	Continue	Soybeans	Cotton, vetch	Soybeans—Plant Ogden beans 1-1½ bu. per acre	Cotton—same as above Soybeans—No fertilizer
21	11.5	Cotton	Soybeans (oats)	Oats, followed by millet or sudan	Continue Continue	Oats—3 bu. per acre in September Millet or sudan—30 pounds per acre	Cotton—90 lbs. nitrogen Oats—60 lbs. N. Sept.; 30 lbs. N. Feb Millet or sudan—30 lbs. N. per acre
16	6.5	Corn, followed by vetch	Continue	Continue	Continue	Corn—13 to 15" apart	Good growth of vetch plus 90 lbs. of nitrogen per ac.
2 4 6 8 11 13	5 2.5 2.5 2.0 2 11	Soybeans	Soybeans	Soybeans, followed by oats	Oats Lespedeza	Lespedeza—30 lbs. in March	Oats—30 lbs. of nitrogen when planted and 30 lbs. nitrogen as top dressing
15	14.5	Oats (seeded fall of 1953), Millet or sudan	Oats Lespedeza	Oats, followed by fescue & white cl.	Fescue & white clover	Fescue—10 lbs. per ac. in October White clover—2 lbs. per acre (1 mo. after fescue)	Fescue—30 lbs. N. when planted, 60 lbs. N. the following Oct.
17	11	Oats (seeded fall of 1953), Lespedeza	Oats, followed by millet or sudan	Dallis grass & lespedeza	Continue	Dallis grass—15 lbs. per acre in March Lespedeza 15 lbs. per ac. in March	Dallis grass—30 lbs. N. in June & 30 lbs. N. in Sept. Have soil analyzed for lime and phosphorus deficiency
19	25	Bermuda Rye grass White clover	Continue	Continue	Continue	Bermuda—sprig area Feb. Rye grass—15 lbs. per ac. & White cl.—2 lbs. per. ac., Oct.	Bermuda—30 lbs. per acre when sprigged Rye grass 30 lbs./ac. when planted
20	33	Dallis grass Lespedeza	Continue	Continue	Continue	Same as field No. 17	Same as field No. 17
22	33	Fescue & White clover	Continue	Continue	Continue	Same as field No. 15 (seeded in Oct. 1953)	Same as field No. 15
18	8	Fescue & White clover	Continue	Continue	Continue	(Fescue established) White cl.—2 lbs./ac. Oct.	60 lbs. nitrogen in Oct. 1953
24	28	Johnson grass	J. grass Red cl.	J. grass Red cl. Win. peas	Continue	Red cl.—15 lbs./ac. in Oct. Winter peas—50 lbs./ac. in Sept.	Johnson grass—40 lbs. N. April Have soil analyzed for fertilizer needs of red clover and winter peas
9 23	2.8 2	Proposed house sites & truck crops Proposed house sites & truck crops				Contact Home Demonstration Agent for Seeding & Fertilizer Recommendations	
Bayou & adjacent escarpment (13) acres use for forest and wildlife							

located area of well planned truck crops can benefit all.

The soil map can be used to group soils that have similar characteristics and require similar treatments into one field. Figure 5 shows the permanent field layout of the farm. Row direction is indicated on the map. Each field is numbered to facilitate easy reference to the proposed land use. The soils of fields 1, 3, 7, 10, and 14 are well adapted to cotton and this crop may be grown continuously if followed by winter legumes each year. The soils of fields 5 and 12 are fairly well adapted to cotton, but should be followed by winter legumes each year. However, these soils yield best when rotated with summer legumes at least once every three years. The soil of field 16 is well adapted to cotton or corn. It is recommended for corn since this area could produce all the corn that would be used on this farm. Part of field 21 is well adapted to cotton. However, because of its size and location in relation to the other cotton soils, it is recommended that this field eventually be put into pasture, to which it is also well adapted. Fields 2, 4, 6, 8, 11, and 13 contain soils that are a high risk when planted in cotton or corn very often. These areas are fairly well adapted to pastures, soybeans, and hay crops; but they are too small in area to be individually fenced. Therefore, soybeans or hay crops may be harvested from these areas. The soils of fields 15, 17, 18, 19, 20, 22, and 24 are well suited to pasture plants; and they have sufficient acreage to merit fencing. Table 6 shows the acreage of each of the above mentioned fields with their proposed cropping system.

It is realized that all of the suggestions listed in the cropping calendar cannot be accomplished in one year, but must be adjusted to fit the individual.

Soil Series and Soil Types of Sunflower County

DOWLING SERIES

The Dowling series is composed of poorly drained soils derived largely from the Mississippi River slackwater deposits, but may include a component of local alluvium washed and sloughed down from the surrounding soils. They occupy the low swags, or depressions, of the area. These soils are frequently covered by water and are slightly to medium acid in reaction.

Soil types within the Dowling series:
210 Dowling soils
212 Dowling clay
213 Dowling silty clay

Soil Profile: (212 Dowling clay) The surface layer of this soil is a very dark gray clay, 2 to 3 inches thick. Just beneath the surface the subsoil begins and is a dark gray to gray clay, mottled with various shades of brown, 36 to 40 inches thick. The subsoil has a bluish gray appearance.

SOUVA SERIES

The Souva series includes the somewhat poorly drained soils derived largely from local alluvium washed or sloughed down from the surrounding soils such as Bosket, Dubbs, and Dundee series. They occupy low swags, or depressional, areas. These soils are covered with water for short periods after each large rain, as they are surrounded by higher soils. They are slightly to medium acid.

Soil types within the Souva series:
234 Souva silty clay loam
235 Souva silt loam

Soil Profile: (235 Souva silt loam) The surface of this soil is a dark brownish gray, friable silt loam, 5 to 10 inches thick. The subsoil is a grayish brown, friable, silty clay loam, mottled with various shades of gray, yellow, and brown, 15 to 20 inches thick. Beneath this is gray, silty clay to silty clay loam material,

Good pastures can be developed on Alligator clay (312) soil. Some farmers utilize pastures for the production of sheep. (Courtesy of S. C. S.)

mottled with shades of gray, yellow, and brown. The soil is slightly to medium acid in reaction.

ALLIGATOR SERIES

The Alligator series includes poorly drained soils derived from the fine-textured, light colored, Mississippi River alluvium. They occur in the low slackwater areas of the floodplain and are locally called gumbo, or buckshot, soils. They occupy level to sloping topography and are found in many localities in the county. These soils are medium to strongly acid in reaction. Approximately 48 percent of the county is comprised of the Alligator, Sharkey, and Dowling series.

Soil types within the Alligator series:

312 Alligator clay
313 Alligator silty clay
314 Alligator silty clay loam

Soil Profile: (312 Alligator clay) The surface layer of this soil is a grayish brown clay, very plastic when wet, firm when moist, very hard when dry, and 2 to 4 inches thick. The subsoil is a gray clay, distinctly mottled with yellowish brown, very plastic when wet, firm when moist, very hard when dry, and slowly permeable to water. Other than a difference in surface texture, Alligator silty clay and Alligator silty clay loam are essentially the same as Alligator clay.

PENJUR SERIES

The Penjur series includes poorly drained soils derived from dark-colored, fine-textured Mississippi River alluvium. This series is found on nearly level topography in the wide flats of old cypress brakes. It is an infrequently found series and occupies less than one square mile of land area in Sunflower County. It is neutral to slightly alkaline in reaction.

Soil types within the Penjur series:

d312 Penjur clay

Soil Profile: The surface layer is a black to very dark gray clay, 2 to 4 inches thick. The subsoil is a black to very dark gray, faintly mottled clay in the upper portion and in the lower portion it is a gray to dark gray clay, mottled with various shades of brown; very plastic when wet; firm when moist; very hard when dry; slowly permeable to water. Decaying pieces of wood are found throughout the profile.

SHARKEY SERIES

The Sharkey series includes poorly drained soils derived from dark-colored, fine-textured Mississippi River alluvium. They occur in the low slackwater areas of the floodplain and are locally called buckshot, or gumbo, soils. They differ from the Alligator series in that the subsoil is much darker in color. They occupy level to sloping topography and are medium acid in reaction.

Soil types within the Sharkey series:

322 Sharkey clay
323 Sharkey silty clay
324 Sharkey silty clay loam

Soil Profile: (322 Sharkey clay) The surface layer is a very dark grayish brown clay, very plastic when wet, firm when moist, very hard when dry, and 2 to 4 inches thick. The subsoil is a very dark gray clay, faintly mottled with shades of brown and gray; very plastic when wet; firm when moist; very hard when dry; slowly permeable to water; and 36 to 40 inches thick. Other than a difference in surface texture, Sharkey silty clay and

Rice produces high yields on Alligatoı clay (312) soils. This is a good use for the poorly drained "gumbo" soils. (Courtesy of Miss. Extension Service.)

Soybeans in rows growing on 322, Sharkey clay. The field of soybeans averaged approximately 40 bushels per acre.

Sharkey silty clay loam are essentially the same as Sharkey clay.

TUNICA SERIES

The Tunica series includes somewhat poorly drained soils derived from the Mississippi River alluvium. They resemble the Sharkey series, with which they are closely associated, but differ from them in having sandy material at depths ranging from 18 to 30 inches. This sandy material gives the Tunica series better internal drainage than the Sharkey series. The Tunica soils occupy gently undulating topography in the slackwater areas of the county. These are very infrequently found soils that usually occur on the highest elevations in the slackwater areas where Sharkey soils predominate. Only a few small areas of the Tunica soils were found in the county, those being located in the northwest portion. They are slightly to medium acid in reaction.

Soil types within the Tunica series:
333 Tunica silty clay

Soil Profiles: The surface layer of this soil is a dark grayish brown clay, very plastic when wet, firm when moist, very hard when dry, and 3 to 4 inches thick. The subsoil is a very dark gray to very dark grayish brown clay, mottled with shades of gray and brown; very plastic when wet; firm when moist; very hard when dry; slowly permeable to water; and 16 to 20 inches thick. Beneath this, the texture becomes a sandy clay loam, mottled with shades of gray and yellow.

FORESTDALE SERIES

The Forestdale series includes poorly to somewhat poorly drained soils that were derived from stratified, medium, and fine-textured Mississippi River alluvium. These soils, occupying level to sloping topography, occur on the lower elevations of the old natural levee formations and are a part of the stratified (low terrace) group of soils. They have been free from overflow water long enough to have a significant amount of profile development and are medium to strongly acid in reaction.

W ditches established in the depressional areas remove surface water fairly rapidly. (Courtesy of S. C. S.)

Soil types within the Forestdale series:
423 Forestdale silty clay
424 Forestdale silty clay loam
425 Forestdale silt loam
426 Forestdale very fine sandy loam

Soil Profile: (425 Forestdale silt loam) The surface layer of this soil is a light brownish gray, friable, silt loam, 4 to 6 inches thick. The subsoil is a light brownish gray silty clay, mottled with shades of gray, yellow, and brown; plastic when wet; firm when moist; very hard when dry; slowly permeable to water; 16 to 18 inches thick. Beneath the subsoil is a layer of gray silty clay loam, mottled with shades of yellow and brown.

Other than a difference in surface texture, Forestdale very fine sandy loam, Forestdale silty clay loam, and Forestdale silty clay are essentially the same as Forestdale silt loam.

DUNDEE SERIES

The Dundee series includes somewhat poorly to moderately well drained soils that were derived from medium, and fine textured Mississippi River alluvium. These soils, occupying gently undulating to sloping topography, occur on the intermediate elevations of the old natural levee formations and are in the stratified (low terrace) group of soils. They have been free from overflow water long enough to have a significant amount of profile development. They are medium acid in reaction.

Soil types within the Dundee series:
433 Dundee silty clay
434 Dundee silty clay loam
435 Dundee silt loam
436 Dundee very fine sandy loam

Soil Profile: (435 Dundee silt loam) The surface layer of this soil is a light brownish gray, friable, silt loam, 4 to 6 inches thick. The subsoil is a yellowish brown silty clay, faintly mottled with shades of gray and yellow; moderately plastic when wet; firm when moist; hard when dry; moderately slowly permeable to water; 16 to 18 inches thick. Beneath the subsoil is a grayish brown layer of silty clay loam to sandy clay loam, distinctly mottled with shades of yellow and brown. Dundee silty clay and Dundee silty clay loam soil types have slightly heavier profiles throughout than the Dundee silt loam; whereas, the Dundee very fine sandy loam has a slightly sandier profile throughout than the Dundee silt loam.

DUBBS SERIES

The Dubbs series includes moderately well drained soils that were derived from stratified beds of medium textured Mississippi River alluvium. These soils occur on the higher elevations of the old natural levee formations and are a part of the stratified (low terrace) group of soils. This series occupies gently undulating and undulating topography and has been free from overflow water long enough to have a significant amount of profile development. They are medium acid in reaction.

Soil types within the Dubbs series:
445 Dubbs silt loam
446 Dubbs very fine sandy loam

Soil Profile: (446 Dubbs very fine sandy loam) The surface layer of this soil is a pale brown, very friable, very fine, sandy loam; 6 to 8 inches thick. The subsoil is a brown, friable, silty clay loam; moderately plastic when wet; firm to friable when moist; slightly hard when dry; moderately permeable to water; 12 to 14 inches thick. Below the subsoil there is a light yellowish brown, very friable, sandy loam layer. The profile is relatively free of mottles or discolorations. Other than a difference in surface texture, the other soil types of this series are essentially the same as Dubbs very fine sandy loam.

BOSKET SERIES

The Bosket series includes well drained soils that were derived predominantly from medium textured Mississippii River alluvium. These soils, occupying gently undulating and undulating topography, occur on the higher elevations of the old natural levee formations and are a part of the stratified (low terrace) group of soils. They have been free from overflow water long enough to have a significant amount of profile development. These infrequently found soils occur in very small areas and have a very small total acreage in the county. They are medium to slightly acid in reaction.

Soil types within the Bosket series:
456 Bosket very fine sandy loam
457 Bosket fine sandy loam

Soil Profile: (456 Bosket very fine san-

Dallis grass and lespedeza make good hay and pasture on the "gumbo" (clay) soils. (Courtesy of S. C. S.)

dy loam) The surface layer of this soil is a light brownish gray, very fiable, very fine, sandy loam, 7 to 9 inches thick. The subsoil is a dark brown to brown, friable, sandy clay loam; slightly plastic when wet; friable when moist; moderately rapidly permeable to water; 16 to 18 inches thick. Below the subsoil is a layer of yellowish brown, friable, sandy loam. Other than a difference in surface texture, the Bosket fine sandy loam is essentially the same as the Bosket very fine sandy loam.

BEULAH SERIES

The Beulah series includes somewhat excessively drained soils that were derived from Mississippi River sandy textured alluvium. These very infrequently found soils, occupying gently undulating and undulating topography, occur on the higher elevations of the old natural levee formations and belong in the stratified (low terrace) group of soils. They are medium to slightly acid in reaction.

Soil types within the Beulah series:
466 Beulah very fine sandy loam
467 Beulah fine sandy loam

Soil Profile: (467 Beulah fine sandy loam) The surface layer of this soil is a light brownish gray, very friable, fine sandy loam, 8 to 10 inches thick. The subsoil is a light yellowish brown, very friable, fine sandy loam, rapidly permeable to water, 22 to 26 inches thick. Below the subsoil is a layer of light yellowish brown, very friable, sandy loam to loamy sand.

340 SHARKEY-CLACK SOILS

This is a complex of soils which may include any or all of the soil types found in the Sharkey, Tunica, Forestdale, Dundee, Bosket, Beulah, and Clack series.

There is no regularity or pattern in the occurence of these different soil types. They are so mixed in their occurrence until separation between types cannot be shown on the soil map with the scale used. The fine-textured slackwater soils predominate with spots of the sandier soils (often somewhat droughty to droughty) being scattered throughout the complex area. These areas, occurring on gently undulating to sloping topography, are not extensive in the county.

460 DUNDEE-CLACK SOILS

This is a complex of soils that may include any or all of the soil types found in the Dundee, Dubbs, Bosket, Beulah, and Clack series. The surface textures are usually variable with any of the textures from a silty clay loam to a fine sandy loam occurring over most any of the subsoils contained in the above group of soil series. There is a complete lack of uniformity as to how these soils are arranged into the general pattern of occurrence. The soil type may, and usually does, change in a matter of a few feet. These soils occur on gently undulating to sloping topography.

DYER SERIES

The Dyer series includes poorly drained, silty natured, depressional soils that occupy the low swag throughout the Dexter, Pearson, and Brittain series. Only one soil type of this series occurs in the county. It was derived largely from local alluvium washed or sloughed down from the surrounding higher areas of silty textured soils. This soil is covered with water for short periods following each large rain, as the excess surface water from the adjacent higher land tends to accumulate in these depressions. The soil is medium to strongly acid.

Soil types within the Dyer series:

T624 Dyer silty clay loam

Soil Profile: The surface layer is a pale brown to grayish brown, silty clay loam, 4 to 6 inches thick. The subsoil is a silty clay loam to silty clay, containing variable colors of mottled light gray, grayish brown, and pale brown, 20 to 24 inches thick.

BRITTAIN SERIES

The Brittain series includes poorly to somewhat poorly drained soils derived from silty alluvium on the old natural levee formations and are a part of the stratified (low terrace) silty group of soils. These soils have been free from overflows long enough to have some profile development and are medium to strongly acid. Only one soil type of the series was found in this county and it occupies gently undulating topography. This series occupies the poorest drained position of the Dexter (moderately well to well drained) — Pearson (somewhat poorly to moderately well drained) — and Brittain (poorly to somewhat poorly drained) soil associiation.

Soil types within the Brittain series:

T825 Brittain silt loam

Soil Profile: The surface layer of this soil is a grayish brown, mellow, silt loam, 6 to 8 inches thick. The subsoil is a gray to light gray, friable, silt loam, mottled with shades of brown and yellow, slowly permeable to water, 24-28 inches thick. Beneath the subsoil there is mottled silty clay loam material.

PEARSON SERIES

The Pearson series includes somewhat poorly to moderately well drained soils derived from silty alluvium on the old natural levee formations. They are associated with the Dexter and Brittain series. These soils have been free from overflows long enough to have some profile development. They are a part of the stratified (low terrace) silty group of soils and are medium acid in reaction. They occupy gently undulating and undulating topography.

Soil types within the Pearson series:

T835 Pearson silt loam

Soil Profile: The surface layer of this soil is a pale brown, mellow, silt loam, moderately slowly permeable to water, 6 to 8 inches thick. The subsoil is a pale brown, silty clay loam, mottled with shades of gray, 9 to 11 inches thick. Beneath the subsoil is a third layer of grayish brown silty clay, 2 to 3 inches thick. Beneath this layer there is brown, silty clay loam material, prominently mottled with light gray.

DEXTER SERIES

The Dexter series includes moderately well to well drained soils that were derived from silty alluvium on the old natural levee formations. They are a part of the stratified (low terrace) silty group of soils. This series is the best drained of the Dexter (moderately well to well drained)—Pearson (somewhat poorly to moderately well drained)—and Brittain (poorly to somewhat poorly drained) soil association. These soils have been free from overflows long enough to have some profile development and are medium acid in reaction. They occupy gently undulating topography in this county.

Soil types within the Dexter series:
T845 Dexter silt loam

Soil Profile: The surface layer of this soil is a pale brown, very friable, silt loam, 6 to 8 inches thick. The subsoil is an almost mottled-free, dark brown, silty clay loam, moderately permeable to water, 8 to 10 inches thick. Beneath the subsoil there is yellowish brown to dark brown, silty clay loam to very fine sandy loam material.

INDEX

Soil Number	Land Class	Page No.
210A	IIIw3	25
212A	IVw3	26
213A	IVw3	26
234A	IIw1	23
235A	IIw1	23
312A1	IVw2	25
312B1	IIIs2	24
312C1	IIIe4	24
312C2	IIIe4	24
312D2	IVe2	25
313A1	IVw2	25
313B1	IIIs2	24
313C1	IIIe4	24
313C2	IIIe4	24
314A1	IIIw2	25
314B1	IIs3	23
d312A1	IIIs2	24
322A1	IVw2	25
322B1	IIIs2	24
322C1	IIIe4	24
322C2	IIIe4	24
322D2	IVe2	25
323A1	IVw2	25
323B1	IIIs2	24
323C1	IIIe4	24
323C2	IIIe4	24
324A1	IIIw2	25
324B1	IIs3	23
333B1	IIs1	22
340B1	IIIs2	24
340C2	IIIe4	24
340D2	IVe2	25
423A1	IVw2	25
423B1	IIIs2	24
423C1	IIIe4	24
423C2	IIIe4	24
424A1	IIIw2	25
424B1	IIs3	23
424C1	IIIe4	24
424C2	IIIe4	24
424D2	IVe2	25
425A1	IIIw1	25
425B1	IIs2	22
425C1	IIIe3	24
425C2	IIIe3	24
425D2	IVe1	25
426A1	IIIw1	25
426B1	IIs2	22
426C1	IIIe3	24
426C2	IIIe3	24
433B1	IIs1	22
434B1	IIs1	22
434C1	IIIe2	24
434C2	IIIe2	24
434D2	IVe2	25
435B1	I	22
435C1	IIe1	22
433C2	IIIe1	23
435D2	IVe1	25
436B1	I	22
436C1	IIe1	22
436C2	IIIe1	23
436D2	IVe1	25
445B1	I	22
445C1	IIe1	22
445C2	IIIe1	23
446B1	I	22
446C1	IIe1	22
446C2	IIIe1	23
456B1	I	22
456C2	IIIe1	23
457B1	I	22
457C2	IIIe1	23
460B1	IIs4	23
460C1	IIIs1	24
460C2	IIIs1	24
460D2	IVe1	25
466B1	IIs4	23
467B1	IIs4	23
467C2	IIIs1	24
T624A	IIIw3	25
T825B1	IIs2	22
T835B1	I	22
T835C2	IIIe1	23
T845B1	I	22

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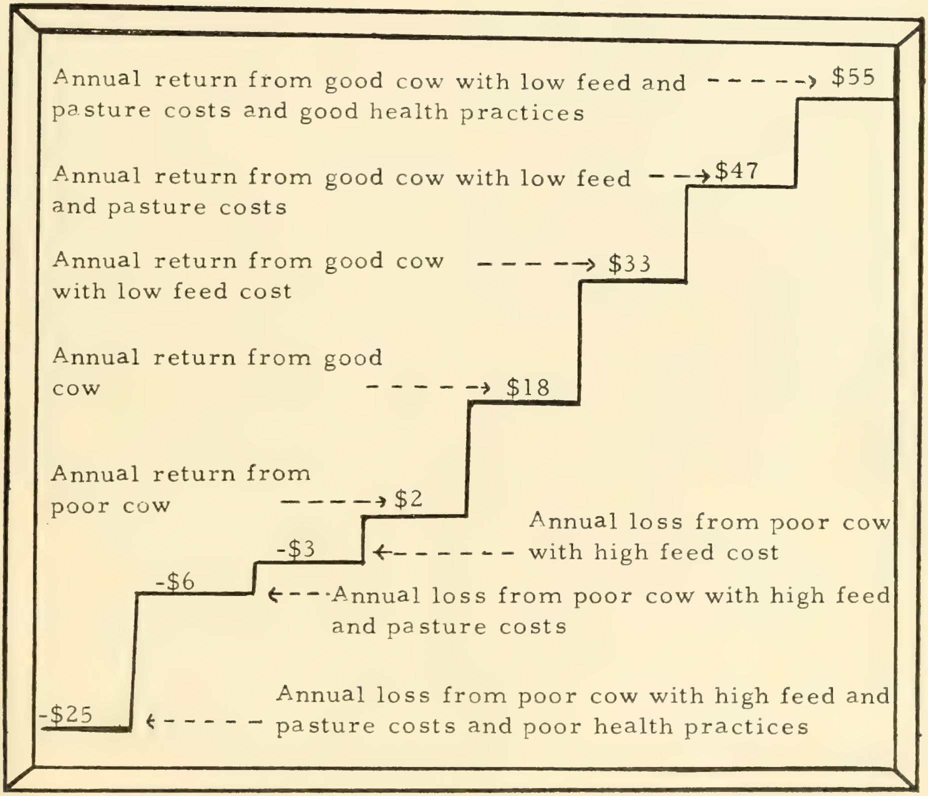
*Note—Alligator clay has the soil number 312 on most of the maps; however, on some previous mapping the number 422 was used to denote this soil. Where the soil number 422 appears on the map, remember its correct number is 312.

BULLETIN 497 FEBRUARY, 1953

AN ECONOMIC APPRAISAL OF
Beef Cattle Production
IN NORTHEAST AND EAST CENTRAL MISSISSIPPI



MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

TABLE OF CONTENTS

Title	Page
LIST OF TABLES	3
APPENDIX TABLES	3
Introduction	5
The Problem	5
Method of Study	5
System of Farming	6
Land Use	6
Cropping Pattern	6
Livestock System	6
Farm Labor Supply	6
Farm Equipment	7
Farm Buildings	7
Management Practices	7
Pastures	7
Feeding	10
Labor Utilization	10
Breeding	10
Buying and Selling Beef Cattle	11
Health	12
Investment, Costs, and Returns	12
Investment	12
Costs	13
Returns	15
Management Practices and Other Factors Influencing Profit Per Cow	15
Herd Size	16
Years in Beef Production	16
Date of Calving	16
Quality of Cows	16
Feeding Practices	16
Pasture Management	17
Health Practices	18
Combined Effect of Several Management Practices on Profits Per Cow	18
Summary and Conclusion	19
Appendix I, Methods Used in Calculating Investment, Costs, and Returns	23
Appendix II, Statistical Tables	25

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Especial appreciation is expressed to the 139 beef cattle owners in the area who provided information for the study. Without their cooperation, this study would have been impossible.

Mr. W. E. Hall, Mr. A. D. Seale, Mr. A. F. Estes, and Mr. D. R. Bryan, graduate students in the Department of Agricultural Economics, collected most of the farm data. Mr. W. E. Hall used part of the information included in this report for his Master's thesis.

COVER CHART:

The study of records of 139 beef cattle farms for 1949-50 showed that on the average, returns to the beef enterprise were relatively low. Relatively high returns were obtained on those farms where the better management practices were used but the beef enterprise was a losing proposition on those farms using poor practices. The effect of poor health practices as shown in the above chart is probably magnified, because of low production on the farms involved.

LIST OF TABLES

Table Page
1. Investment in the beef enterprise per farm and per cow 13
2. Total cost per farm and per cow 14
3. Total returns and returns to investment 15

APPENDIX TABLES

Table Page
1. Land use 25
2. Cropping pattern 25
3. Power and equipment used 26
4. Buildings used in connection with the beef enterprise 26
5. Total replacement cost of buildings per farm and replacement cost to the beef enterprise per farm 27
6. Building cost per farm and per cow 27
7. Age and sex distribution of family labor force 28
8. Age of operators, 139 beef cattle farms 29
9. Hours of labor used per cow 29
10. Beef cattle numbers, 139 beef cattle farms 30
11. Percentage of specified animals sold by months 31
12. Ages at which cows and calves were sold 32
13. Percentage of animals purchased by month 31
14. Percentage of calves born during each month and percent calf crop 32
15. Health practices 33
16. Death losses and other factors 33
17. Beef production per farm 34
18. Other livestock production 35
19. Land preparation, fertilization, and seeding practices, all improved permanent pasture 36
20. Annual land preparation, fertilization, and seeding practices, temporary winter pasture 37
21. Annual land preparation, fertilization, and seeding practices, temporary summer pasture 37
22. Land preparation, fertilization, and seeding practices, open permanent pasture, improved by land preparation, fertilization, and seeding 38
23. Annual land preparation, fertilization, and seeding practices, specified grazing crops 39
24 Percentage of improved permanent pasture improved by specified methods and percentage of temporary grazing crops that were specified crops 39
25. Cost of establishment and annual cost for all improved permanent pasture 40
26. Annual cost per acre unimproved permanent pasture, woodland pasture, temporary winter pasture, and temporary summer pasture 40
27. Cost of establishment and annual cost per acre for improved permanent pasture improved by land preparation, fertilization, and seeding 41
28. Annual cost per acre, specified grazing crops 41
29. Replacement cost and annual cost of one mile of fence 41
30. Acres of pasture per farm and per cow and annual pasture cost per farm and per cow 42
31. Pasture credits, improved permanent pastures 42
32. Pasture credits, temporary winter pasture 43
33. Pasture credits, temporary summer pasture 43
34. Source of water 43
35. Quantities of feed used per farm and per cow 44
36. Marketing cost per farm and per cow 44
37. Miscellaneous cost per farm and per cow 45
38. Herd size related to costs and returns per cow 45
39. Years in beef production related to costs and returns per cow 45
40. Date of Calving related to cost and return per cow 46
41. Value of brood cows related to costs and returns per cow 46
42. Feed cost related to costs and returns per cow 47
43. Pasture cost per cow related to costs and returns per cow 47
44. Pasture management practices related to costs and returns per cow 48
45. Health and sanitation practices related to costs and returns per cow 48
46 Combined effect of quality of cows, feed cost, pasture cost, and health and sanitation practices on costs and returns per cow 49

APPENDIX TABLES (Continued)

47. Prices used for pasture credits 50
48. Fertilizer prices per ton 50
49. Feed prices 50
50. Seed price per pound 50
51. Cost per acre once over for pasture land preparation and mowing 51
52. Average price received for beef animals 51

AN ECONOMIC APPRAISAL OF BEEF CATTLE PRODUCTION IN NORTHEAST AND EAST CENTRAL MISSISSIPPI

By T. E. TRAMEL and D. W. PARVIN

Introduction

The Problem. As a result of a decline in the farm labor supply during the past decade, many Mississippi farmers have had to make major adjustments in order to obtain the best use of all resources on the farm. Enterprises with relatively small labor requirements have been substituted for those requiring more labor. Relatively low labor requirements and comparatively high prices have made the production of beef cattle attractive to many farmers facing an adjustment in their system of farming.

A number of farmers in the state have made a complete change from row crops to beef cattle. Others have combined the production of beef cattle and row crops. Many others are contemplating using beef cattle to replace or supplement existing enterprises.

The proportion of total farm income from the sale of beef cattle increased more than 50 percent from the 1940-44 period to the 1945-49 period.[1] This demonstrates the increasing importance of beef cattle in the economy of the state. Further increases may be expected as a result of the continued shortage of farm labor and a continued high demand for beef.

It is essential that farmers who are getting into the business have information as to resources needed, recommended management practices, and the production that can be expected. This study was devised to provide this information as well as to point out weaknesses in present management practices. Specifically, the objectives of this study are:

1. To determine the resources used in beef production and the investment required.
2. To determine the costs and returns involved.
3. To determine management practices used and their effect on costs and returns.
4. To point out weaknesses in present management practices and suggest ways by which beef production can be made more profitable.

Method of Study. Data for the study were obtained by personal interview with 139 producers in Northeast and East Central Mississippi. The farms studied were located in Alcorn, Calhoun, Chickasaw, Lauderdale, Leake, and Noxubee Counties. A list of beef cattle producers was secured from the Agricultural Extension Service and supplemented by agricultural workers in each county. In each county, insofar as was possible,[2] all beef cattle producers were interviewed who owned an average of 10 or more beef cows or who sold 10 or more beef animals during the year studied. However, schedules were not obtained from those producers who were also cattle traders. Detailed information in regard to practices used in all phases of the beef enterprises as well as input-output data were secured. Methods of calculating costs and returns are given in Appendix I.

In order to determine the extent to which the soil area influenced production practices, farms in the three major soil areas were studied separately.[3] The data presented in the following tables as the average for all areas include, in addition to the three major areas, 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

---

[1] "Farm Income Situation" and other reports of the Bureau of Agricultural Economics, USDA, Washington, D. C. These reports show that during the five-year period, 1940-44, the sale of cattle and calves made up 5.7 percent of the total farm income. For the five-year period, 1945-49, this percentage had increased to 8.8.

[2] If a schedule was not obtained in three visits to a farm, that producer was dropped from the sample.

[3] Sand Clay Hills, Mixed Brown Loam and Northeast Prairie.

System of Farming

Land Use. Because of the nature of the enterprise, the farms studied were much larger than the average operating unit in the areas studied, 662 areas compared to less than 140 acres[4] (Appendix Table 1). The farms studied were much larger in the Northeast Prairie than in the other two areas, almost 1,100 acres compared to about 500 acres.

Total land area on the farms studied in the Mixed Brown Loam was almost equally divided between open land and woodland. On the other hand, beef cattle farms in the Sand Clay Hills had about one-fourth more open land than woodland, and those in the Northeast Prairie had almost four times as much open land as woodland. The average for all areas studied was about twice as much openland as woodland.

Wooded areas were used to supplement grazing from open permanent pasture on 109 of the 139 farms studied. The proportion of the total acreage of woodland grazed ranged from 50 percent in the Northeast Prairie to 62 percent in the Sand Clay Hills and averaged 53 percent for all areas studied.

On the farms studied, the use made of open land varied widely between individual farms as well as between areas. In the Mixed Brown Loam there were 143 acres of cropland for every 100 acres of open permanent pasture land, while in the Sand Clay Hills there were 98, and in the Northeast Prairie only 73. The average for all areas studied was 92 acres of cropland for every 100 acres of open pasture land.

Cropping Pattern. Although the cropping pattern varied widely between individual farms, there were few marked differences between areas (Appendix Table 2). Cotton, corn, hay, and temporary winter pasture were the principal crops grown and accounted for an average of 93.5 percent of the cropland on all farms studied.

Due to soil conditions in the Northeast Prairie, a larger proportion of the total cropland was used for the production of hay and a smaller proportion for the production of corn than in the other two areas. Two crops, usually temporary winter pasture and hay, were grown on about 8 percent of the cropland during the year. A very small percentage of the open permanent pasture acreage was also seeded to some crop, usually oats, for temporary winter pasture.

Livestock System. Livestock enterprises of commercial importance were found on about three-fourths of the farms studied in the Northeast Prairie, on about one-half of those in the Mixed Brown Loam area and on about one-fourth of those in the Sand Clay Hills. Hogs were produced commercially on more beef cattle farms than any other livestock enterprise. However, in the Northeast Prairie a sheep enterprise was more prevalent and a dairy enterprise almost as prevalent as the hog enterprise (Appendix Table 18). Hogs were produced commercially on 33 percent of the farms studied, sheep on 13 percent, and dairy cattle on 11 percent. Only one of the 139 farms studied had as many as 300 laying hens.

The beef cattle herds were much larger in the Northeast Prairie than in the other two areas. The number of cows per farm averaged 75 in the Northeast Prairie, 33 in the Sand Clay Hills and 24 in the Mixed Brown Loam. The average for all farms studied was 42 (Appendix Table 10).

Farm Labor Supply. There was an average of 3.4 members of the operator's family on the farm for all farms studied.

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[4] Estimation based on Census of 1950.

There were only 2.9 in the Northeast Prairie compared to 3.7 in the other two areas (Appendix Table 7). Males averaged 54 percent and females 46 percent of the total number. In the Sand Clay Hills, males and females were equally divided, but in the Mixed Brown Loam and the Northeast Prairie, males constituted 56 percent and 60 percent, respectively, of the total.

Operators of beef cattle farms in the Northeast Prairie were, on the whole, younger than operators in the other two areas. More of them were less than 40 years of age and fewer were over 70 (Appendix Table 8). In each area more than half of the operators were between 40 and 60 years of age. The average length of time that all operators interviewed had been producing beef cattle was about 13 years.

In addition to the family labor force, most farms had croppers, wage hands, or both. About 70 percent of the total acreage of cotton was worked by croppers in each of the three areas. Only 22 percent of the corn acreage in the Northeast Prairie was worked by croppers compared to 46 percent in the Mixed Brown Loam and 55 percent in the Sand Clay Hills—an average of 47 percent for all farms.

The remaining acreage of cotton and corn and all other crops was handled by the operator's family and wage hands. About 530 days of wage labor were hired per farm in the Northeast Prairie, 110 in the Mixed Brown Loam, and 200 in the Sand Clay Hills. About 70 percent of all wage labor was hired by the day rather than by the month.

Farm Equipment. Even though tractors and some types of tractor equipment were found on about three-fourths of the farms studied, workstock were also found on practically all farms (Appendix Table 3). Workstock per farm numbered nine in the Northeast Prairie and five in each of the other two areas.

On the whole, because farms were larger, more equipment was found on farms in the Northeast Prairie than in the other two areas. Fewer farms in the Sand Clay Hills had equipment for saving hay and harvesting seed than in the other two areas.

Farm Buildings. The general barn was used in connection with the beef enterprise on 83 percent of the farms studied. Fewer producers in the Northeast Prairie use the general barn for this purpose than in the other two areas, 66 percent compared to 88 percent and 90 percent for the Sand Clay Hills and Mixed Brown Loam (Appendix Table 4). In contrast, a larger proportion of producers in the Northeast Prairie had a hay barn, separate from the general barn, that was used to store hay for the beef enterprise, (45 percent compared to 20 percent in the Mixed Brown Loam and 29 percent in the Sand Clay Hills).

Of all farms studied, 4 percent used loafing barns, temporary shelters, other grain storages, and silos in connection with the beef enterprise. A larger proportion of the producers in the Northeast Prairie used temporary shelters and silos and a larger proportion of those in the Sand Clay Hills used other grain storages. On the whole, producers in the Northeast Prairie had more specialized buildings for use with the beef enterprise than producers in the other areas.

Management Practices

Pastures. There was considerable variation in acreages of pasture per cow between individual farms and, except for temporary winter pasture, between areas as well. Producers in the Northeast Prairie grazed one cow to every 5.2 acres of open permanent pasture compared to one cow to 3.7 acres in the other two areas. The average for all areas studied was one cow to 4.4 acres (Appendix Table 30). In addition to the open permanent pasture, there was an average of .5 acres of temporary winter pasture per cow, 2.6 acres of woodland pasture per cow, and an insignificant amount of temporary summer pasture. Temporary winter pasture averaged .5 acres per cow in each area studied; woodland pasture averaged 3.6, 4.5, and 1.3 acres per cow in the Sand Clay Hills, Mixed Loam, and Northeast Prairie, respectively.

On the 139 farms studied, 125 had made some improvement of open permanent pasture, mostly during recent years. About 53 percent of the total acreage of open permanent pasture was improved.[5] Producers in the Mixed Brown Loam had made some improvement on only 42 percent of their open permanent pastures compared to about 54 percent in the other two areas. However, the level of improvement was higher in the former area.

The proportion of the improved pasture on which a complete job of improvement had been done (seedbed preparation, fertilization, and seeding) was relatively low, 17.3 percent.[6] However, in the Mixed Brown Loam slightly more than two-fifths was improved in this manner compared to 13.4 percent in the Northeast Prairie and 22.5 percent in the Sand Clay Hills (Appendix Table 24). On all farms studied, the proportions of improved permanent pasture that were improved by either land preparation, fertilization or seeding or a combination of two of these practices averaged 45.8 percent; 36.9 percent was improved by mowing.

Superphosphate, basic slag and potash were the minerals commonly used. Superphosphate had been applied to 42.5 percent of the total acreage of improved permanent pasture, basic slag to 20.4 percent and potash to 15.3 percent (Appendix Table 19). Basic slag instead of superphosphate was the usual mineral applied in the Mixed Brown Loam. The rate at which fertilizers were applied was usually lowest in the Sand Clay Hills and highest in the Mixed Brown Loam.

Dallis grass, lespedeza, White Dutch clover, crimson clover and fescue were the pasture plants most often seeded on permanent pasture land in the Mixed Brown Loam and Sand Clay Hills. In the Northeast Prairie, the same pasture plants were used but a larger acreage was seeded to wild winter peas and serecia lespedeza than to Dallis grass and fescue.[7]

Considering all improved permanent pasture, only 23.0 percent was disced and only 5.2 percent broken with breaking plows. However, in the Mixed Loam. 39.6 percent was disced and 13.0 percent broken with breaking plows. A larger proportion was harrowed and/or cultipacked also in this area.

Almost all producers mowed at least a part of the improved permanent pasture. Of the total acreage, 88.6 percent was mowed. Producers in the Northeast Prairie mowed 92.6 percent compared to 75.6 percent in the Sand Clay Hills and 85.6 percent in the Mixed Brown Loam. On the average, mowed areas were mowed 1.9 times.

When land preparation, fertilization, and seedling were all done on the same plot, practically all the land was disced from two to three times and a little more than a third of it was also broken with breaking plows. However, a much smaller proportion was broken with breaking plows in the Sand Clay Hills than in the other two areas, 5.1 percent compared to 40.5 percent in the Mixed Brown Loam and 74.5 percent in the Northeast Prairie (Appendix Table 22). Further land preparation was done in most instances by harrowing and/or cultipacking. More harrowing was done in the Northeast Prairie than in the other two areas. The rate of seeding and fertilization per acre was about the same on land where a complete job of improvement was done as the average for all improved permanent pasture.

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[5] Open permanent pasture where the land had been broken, seeded or fertilized or any combination of these practices. Open permanent pasture which had been mowed every year for the four years immediately preceding the year studied was also classified as being improved.

[6] When all open permanent pasture is considered, a complete job of improvement was done on only 9.2 percent of the acreages.

[7] See Appendix Table 19 for acreages to, and rates per acre where applied.

Temporary winter pasture was provided for the beef enterprise on 64 of the 139 farms studied and averaged about one acre per cow on these farms. Many different combinations of winter growing crops were used. However, for all farms studied, oats alone or in combination with legume, and wild winter peas alone were the predominate type of temporary winter pasture. Wild winter peas was the predominant type of temporary winter pasture in the Northeast Prairie while oats or oats in combination with legume were the predominant types in the other areas (Appendix Table 24). Other winter growing crops, such as Dixie Wonder peas, were used for temporary winter pasture more often in the Sand Clay Hills than in the other areas.

Since a larger proportion of the temporary winter pasture was wild winter peas in the Northeast Prairie than in the other two areas, and since wild winter peas do not require annual planting, less land preparation was done for temporary winter pasture in this area than in the other two areas. More land preparation for temporary winter pasture was done in the Mixed Brown Loam than in the Sand Clay Hills (Appendix Table 20).

When temporary winter pastures were fertilized, nitrogen and/or phosphate were the fertilized elments most commonly used. Nitrogen was applied to 29.8 percent and phosphate to 20.9 percent of the total acreage of temporary winter pasture. Producers in the Mixed Brown Loam applied fertilizer to a larger proportion of their temporary winter pasture than did producers in the other two areas.

There was little difference in the methode of land preparation used when oats were seeded alone or in combination with legume for temporary winter pasture. Practically all the land was disced, about one-fifth broken with breaking plows, about three-fourths harrowed, and about one-fourth cultipacked (Appendix Table 23). There was, however, a decided difference in fertilizer practices. Nitrogen was applied to 81.7 percent of the oats alone compared to 46.3 percent of the other seeded with legumes. Basic slag or lime was applied to over 40 percent of the oats seeded with legumes but to only 3 percent of the oats seeded alone.

Vetch was the legume most often seeded with oats. On the acreage seeded to oats and legumes, vetch was used on 49 percent, wild winter peas on 36 percent, and crimson clover on 25 percent.[8]

Where wild winter peas were seeded alone for temporary winter pasture, only two-thirds of the acreage reported was seeded during the year studied. Of the acreage seeded, about one-half was disced and about one-half harrowed. Phosphate was the only fertilizer applied to wild winter peas seeded alone and was applied to only 8 percent of the total acreage.

Sudan and kudzu were the only two crops used as temporary summer pasture. The small amount of temporary summer pasture was all Sudan in the Northeast Prairie and 59 percent Sudan in the Sand Clay Hills (Appendix Table 24).[9]

On the average, grazing on temporary winter pasture was begun about two weeks later in the Northeast Prairie than in the other two areas, the third week of December compared to the first week of December. Grazing was continued until the last half of March in each of the three areas. During this period, tempor-

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[8] Two legumes were seeded on 10 percent of this acreage.

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[9] See Appendix Table 21 for details regarding land preparation, fertilization, and seeding.

ary winter pasture was grazed about 85 percent of the days. On days when grazing was done, the usual grazing period was 24 hours. However, some producers grazed temporary winter pasture a few hours and then removed the herd.

In addition to the grazing, several, almost one-third, of the producers harvested hay or seed from improved permanent pasture and/or temporary pastures. An average of 3 tons of hay, 155 bushels of oats and 640 pounds of miscellaneous seed were harvested from these pastures per farm for all farms studied (Appendix Tables 31, 32, and 33).[10] Wild winter peas, sericia lespedeza, crimson clover, White Dutch clover, fescue, and vetch were the seeds harvested. Producers in the Mixed Brown Loam harvested a greater quantity of the more valuable seed per acre than did producers in the other areas.

Water for the beef enterprise was supplied from several different sources. From the standpoint of all farms studied, ponds and creeks were of equal importance as sources of water. Each was found on 63 percent of the farms studied. (Appendix 34). Ponds were used more frequently and creeks less frequently in the Northeast Prairie than in the other two areas. Wells were the only sources of water on 10 percent of the farms studied in the Northeast Prairie; while this was not the case on a single farm in either of the other two areas. Two or more sources of water were used on 46 percent of the farms studied. Only about one-third of the producers in the Sand Clay Hills had two or more sources compared to about one-half in the Mixed Brown Loam and about two-thirds in the Northeast Prairie.

Feeding. Very little feed was given beef animals except during the winter and early spring months. In the year studied, feeding was begun on the average about the first week of December in each of the three areas and continued until the latter half of March.

For all farms studied, roughage per cow averaged .8 tons and concentrate 360 pounds (Appendix Table 35).[11] Producers fed 1.1 tons of roughage per cow in the Northeast Prairie, .8 tons in the Mixed Brown Loam, and .6 tons in the Sand Clay Hills. Concentrates fed per cow were highest in the Mixed Brown Loam, 495 pounds compared to 465 pounds in the Sand Clay Hills and 225 pounds in the Northeast Prairie.

The feeding pattern was grass hay and protein supplement in the Northeast Prairie and legume hay and corn in the Mixed Brown Loam. Producers in the Sand Clay Hills had no clearly defined feeding pattern. Of the 139 producers interviewed, 20 fed roughage alone, 1 fed protein supplement alone, 5 fed corn alone, 29 fed roughage and protein supplement, 31 fed roughage and corn, 52 fed roughage, protein supplement and other concentrates,[12] and 1 reported that no feed was given to beef cattle.

From a study of individual records, it appears that the feeding of corn, oats, and hay was governed to some extent by the quantities produced on individual farms. In some cases, the feeding of protein supplement might have been influenced by the farmer having or not having cottonseed to trade for cottonseed meal, pellets, or cake.

Labor Utilization. Labor used per cow varied from 12.9 hours in the Northeast Prairie to 19.1 hours in the Mixed Brown Loam. The average for all areas studied was 15.8, of which 8.9 were for daily chores, 5.5 for feeding, and 1.4 for other jobs such as dehorning, castrating, etc.

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[10] If only the farms harvesting these crops were considered, the amount harvested per farm would be about three times as great.

[11] Includes feed fed to other classes of beef animals and was obtained by dividing the total quantity of each type feed fed to the beef enterprise by the average number of cows.

[12] Primarily corn.

(Appendix Table 9). Hours used per cow were lowest in the Northeast Prairie because of relatively large herds and highest in the Mixed Brown Loam because of relatively small herds.

Breeding. Practically all farms studied used purebred beef bulls and grade beef cows. However, there were a few cases in which the bull and a part or all of the cows were registered. The brood cows averaged 64 percent beef blood in the Mixed Brown Loam, 61 in the Northeast Prairie, 58 in the Sand Clay Hills, and 62 percent on all farms.

Although there were many instances in which young heifers were pastured separately, on the whole, very little controlled breeding was practiced. On most farms, the bull was pastured with the cows and heifers. The natural breeding pattern is such that calves are dropped in the spring. Most cows followed the natural calving pattern. For all farms studied, slightly more than three-fourths of the calves were dropped from January through May (Appendix Table 14). In general, calves were dropped earliest in the Northeast Prairie.

Although there was considerable variation in the calf drop percentage on individual farms, there was little variation among areas. The percentage calf crop, calculated from the average number of cows and heifers over two years and the number of live calves born was 77 in the Sand Clay Hills, 81 in the Mixed Brown Loam, and 80 in the Northeast Prairie, and averaged 78 for all farms.

Buying and Selling Beef Cattle. During the year studied, 90 percent of the beef produced was sold. Of that part sold, calves accounted for 66 percent; cows, 21 percent; steers, 10 percent; and bulls together with heifers, 3 percent (Appendix Table 17).

As a whole, calves sold by producers in the Northeast Prairie were older than those sold by producers in the other two areas. Slightly less than one-half of the calves sold in this area were less than seven months old while in the Mixed Brown Loam almost two-thirds, and in the Sand Clay Hills almost three-fourths of the calves sold fell into this classification (Appendix Table 12). Considering all farms studied, the proportion sold at the different ages was: less than 6 months, 18.3 percent; 6 months, 40.0 percent; 7-8 months, 25.6 percent; and 9-11 months, 15.1 percent.

The average weight at which calves were sold on individual farms varied from 200 pounds to 630 pounds and averaged 383 pounds for all farms. The heaviest calves were sold in the Mixed Brown Loam and the lightest in the Sand Clay Hills, an average of 423 pounds compared to 352 pounds.

The age at which cows were sold showed considerable variation between areas. For example, in the Sand Clay Hills 52.3 percent of the cows sold were in the age group 6-7 years while in the Northeast Prairie only 9.7 percent fell into this classification, but 53.8 percent fell into the classification 8-9 years. Considering all farms studied, almost three-fourths of all cows sold fell into the age group 6-9 years.

Heavy calf marketings occurred during the three-month period August-October; 65 percent were sold during this period. In the Mixed Brown Loam almost three-fourths of the calves sold were sold during this period compared to less than one-half in the Sand Clay Hills (Appendix Table 11).

In the Northeast Prairie, more than half of the cows sold were sold from August through October. April and May were the only months in which there was a concentration of cow sales in the Mixed Brown Loam and there was no apparent concentration in the Sand Clay Hills.

During the year studied, three calves were purchased for every 100 born (Appendix Table 10). In the the Sand Clay Hills, these purchases were concentrated in the three-month period November-January. In the Mixed Brown Loam and Northeast Prairie, calf purchases showed two points of concentration, the spring months and the fall months. (Appendix Table 13). Purchases of cows were concentrated in the spring months in the Sand Clay Hills and Mixed Brown Loam, but in the late summer and early fall months in the Northeast Prairie.

The production of beef for a particular year includes calves raised and sold, calves raised and kept for replacement, weight put on animals purchased, and weight put on animals on hand at the beginning of the year under consideration. During the year studied, the production of beef per farm ranged from 9,248 pounds in the Mixed Brown Loam to 25,137 pounds in the Northeast Prairie (Appendix Table 17). The total production of beef per cow averaged 334 pounds in the Northeast Prairie, 335 pounds in the Sand Clay Hills, and 387 pounds in the Mixed Brown Loam.

Health. As far as can be ascertained from the information secured from producers, there was little difference between areas in the level of health and sanitation practices carried out. For example, a smaller proportion of the producers in the Northeast Prairie treated for grubs, treated for internal parasites, or sprayed for flies, but a larger proportion vaccinated for blackleg, septicemia, or Bangs than was true in the other areas (Appendix Table 15).

For all farms studied, the level of health and sanitation practices carried out was low. In too few cases were preventative measures taken before diseases or parasites were present on the farm. This was especially true of Bangs; only 7 percent of the producers reported vaccinating heifers for Bangs. Of the 139 farms studied, 24 percent treated for grubs and 17 percent for internal parasites; 63 percent sprayed for flies; 75 percent vaccinated for blackleg, 26 percent vaccinated for septicemia, 4 percent vaccinated for pinkeye; 14 percent tested the breeding herd for Bangs, and 1 percent tested for T. B.

Abortions occurred more often in the Northeast Prairie than in the other two areas. Of the average number of cows for the year, 3.0 percent aborted in this area, .4 percent in the Mixed Brown Loam, and 1.6 percent in the Sand Clay Hills. The average for all farms studied was 2.1 percent (Appendix Table 16).

Death losses for cows averaged 3.0 percent for all farms studied. Producers in the Mixed Brown Loam had a death loss of 4.4 percent for cows compared to 2.9 in the Sand Clay Hills and 3.2 percent in the Northeast Prairie. Death losses for calves averaged 4.5 percent for all farms studied. Producers in the Mixed Brown Loam also had the highest death loss for calves, 7.0 percent compared to 4.0 percent in the Sand Clay Hills and 4.8 percent in the Northeast Prairie. A relatively high loss of calves and cows during or shortly after calving and a relatively high loss from bloat resulted in the higher death losses in the Mixed Brown Loam.

Investment, Costs and Returns

Investment. Investment in the beef enterprise includes investment in the breeding herd, pasture land, and buildings. Investment in these three items ranged from $9,255 per farm in the Mixed Brown Loam to $31,736 in the Northeast Prairie and averaged $16,841 for all farms studied (Table 1). Investment per cow ranged from $354 in the Sand Clay Hills to $419 in the Northeast Prairie and averaged $404. Investment per cow was highest in the Northeast Prairie because of a greater investment in the breeding herd and in pasture land.

Investment in the breeding herd ranged from $3,824 in the Mixed Brown Loam to $12,808 in the Northeast Prairie and averaged $6,990 for all farms studied. This is an average of 41 percent of the total investment.

Table 1. **Investment in beef enterprise per farm and per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.**

Item	Soil areas				Soil areas			
	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	Av. all areas[1]	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	Av. all areas[1]
	Dollars per farm				Dollars per cow			
Breeding herd:								
Cows & heifers, 2	4,218	3,098	11,062	5,879	126	130	147	141
Heifers, 1-2	464	409	769	573	14	17	10	14
Bulls, 1	375	317	977	538	11	13	13	13
Total	5,057	3,824	12,808	6,990	151	160	170	168
Pasture land:								
Improved perm.	2,874	2,026	9,886	4,585	86	85	132	110
Unimproved perm.	1,551	1,303	5,322	2,589	47	55	71	62
Temporary winter	599	522	1,564	764	17	23	17	18
Temporary summer	38	------	1	17	1	------	------[2]	------[2]
Woodland	1,074	888	1,126	1,075	32	37	15	26
Total	6,136	4,739	17,899	9,030	183	200	235	216
Buildings:								
General barn	472	517	699	570	14	22	9	14
Hay barn	167	102	262	195	5	4	4	5
Other buildings	37	73	68	56	1	3	1	1
Total	676	692	1,029	821	20	29	14	20
Total investment	11,869	9,255	31,736	16,841	354	389	419	404

[1] Includes 14 farms in the Brown Loam, Pontotoc Ridge, Flatwoods, and Northeast Highlands soil areas.

[2] Less than $0.50.

Investment in the breeding stock averaged $160 per cow and was highest in the Northeast Prairie, $170 compared to $151 in the Sand Clay Hills and $160 in the Mixed Brown Loam. Higher valued cows accounted for this difference. Cows and grown heifers formed the larger part (84 percent) of the investment in the breeding herd.

Pasture land accounted for an average of 54 percent of the total investment in the enterprise. Investment in pasture land ranged from $4,739 to $17,899 per farm and from $183 to $235 per cow. Producers in the Mixed Brown Loam had the lowest investment in pasture land per farm. Those in the Sand Clay Hills had the lowest investment per cow, and those in the Northeast Prairie the highest investment both per farm and per cow. Producers in the latter area had the highest investment per cow in pasture land because they had a greater acreage of open permanent pasture per cow.

On the average, improved permanent pasture accounted for 51 percent of the investment in pasture land, unimproved permanent pasture 29 percent, woodland pasture 12 percent, temporary winter pasture 8 percent and temporary summer pasture less than one-half of one percent.

Buildings used by the beef enterprise accounted for an average of only 5 percent of the total investment in the enterprise. On a per farm basis, investment in buildings ranged from $676 in the Sand Clay Hills to $1,029 in the Northeast Prairie and averaged $821.

Investment in buildings per cow was $29 in the Mixed Brown Loam, $14 in the Northeast Prairie, $20 in the Sand Clay Hills, and an average of $20 for all farms. Larger herds probably accounted for the lower investment in buildings in the Northeast Prairie and smaller herds the higher investment per cow in the

Table 2. Total cost per farm and per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-1950.

Item	Soil area				Soil area			
	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Av. all areas[1]	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Av. all areas[1]
	Dollars per farm				Dollars per cow			
Pastures	706	524	1,508	849	21.17	21.99	20.04	20.40
Feed	781	639	1,782	965	23.43	26.76	23.68	23.19
Buildings	102	101	160	127	3.07	4.23	2.12	3.04
Labor	245	182	388	263	7.36	7.64	5.16	6.32
Marketing	113	44	182	107	3.39	1.85	2.42	2.57
Miscellaneous	163	138	337	202	4.88	5.80	4.48	4.87
Total[2]	2,110	1,628	4,357	2,513	63.30	68.27	57.90	60.39

[1] Includes 14 farms in the Brown Loam, Pontotoc Ridge, Flatwoods, and Northeast Highlands soil areas.

[2] When interest was charged at 5 percent on the total investment, total cost for the Sand Clay Hills, Mixed Brown Loam, Northeast Prairie and average for all areas, respectively, was as follows: per farm; $2,704, $2,091, $5,943, and $3,345; per cow; $81.00, $87.72; $78.85, and $80.50.

Mixed Brown Loam.

The general barn accounted for the larger part of the investment in buildings, an average of about 70 percent. Hay barns accounted for an additional 24 percent.

Costs. Total cost, excluding a charge for interest on investment, averaged $2,573 per farm. Total cost per farm was highest in the Northeast Prairie and lowest in the Mixed Brown Loam, $4,357 compared to $1,628 (Table 2). However, on a per cow basis total cost was highest in the Mixed Brown Loam and lowest in the Northeast Prairie, $68.27 and $57.90. Producers in the former area not only had higher total costs per cow, but each item of cost was higher with the exception of marketing cost. Total cost per cow averaged $60.39 for all farms.

The annual cost of pastures accounted for an average of one-third of the total cost of the enterprise, ranging from a low of $524 per farm in the Mixed Loam to a high of $1,508 in the Northeast Prairie. Pasture cost per cow showed less variation, from $20.04 in the Northeast Prairie to $21.99 in the Mixed Brown Loam. This item averaged $849 per farm or $20.40 per cow.

The annual cost of improved permanent pastures accounted for more than one-half of the total annual cost of pastures in each area and averaged 61 percent of the total on all farms studied. Temporary winter pasture accounted for another 28 percent.

The market value of home-grown feed fed to the beef enterprise and and the cost of purchased feeds amounted to an average of $965 per farm or $23.19 per cow. This was 38 percent of the total cost charged to the enterprise. Feed cost per cow was slightly higher in the Mixed Brown Loam than in the other areas. $26.76 compared to $23.43 in the Sand Clay Hills and $23.68 in the Northeast Prairie.

Concentrates accounted for slightly more than half of the total cost of feed in the Sand Clay Hills, but only 43 percent in the Mixed Brown Loam and only 35 percent in the Northeast Prairie.

The annual cost of buildings for the year studied averaged $127 per farm or $3.04 per cow. This was about 5 percent of the total cost of the enterprise.

At least a part of the labor used in taking care of the beef enterprise on many farms was hired; therefore, all labor was included as an item of cost. On those farms where the operator and his family took care of the enterprise, a more accurate picture of the costs involved may

Table 3. Average total returns and returns to investment, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil area: Sand Clay Hills	Soil area: Mixed Brown Loam	Soil area: Northeast Prairie	Av. all areas[1]	Soil area: Sand Clay Hills	Soil area: Mixed Brown Loam	Soil area: Northeast Prairie	Av. all areas[1]
	Dollars per farm				Dollars per cow			
Value of beef produced	2,274	1,831	4,832	2,924	68.19	76.77	64.21	70.29
Pasture credits	133	242	457	218	3.99	10.11	6.07	5.24
Total returns	2,407	2,073	5,289	3,142	72.18	86.88	70.28	75.53
Less total cost	2,110	1,628	4,357	2,513	63.10	68.27	57.90	60.39
Returns to investment	297	445	932	629	8.88	18.61	12.38	15.14
Percent return to investment	--------	--------	--------	--------	2.51	4.78	2.95	3.75

[1] Includes 14 farms in the Brown Loam, Pontotoc Ridge, Flatwoods, and Northeast Highlands soil areas.

be obtained by deducting labor cost from total cost.

Labor cost per farm ranged from $182 in the Mixed Brown Loam to $388 in the Northeast Prairie and averaged $263 or about 10 percent of the total cost of the enterprise. Labor cost per cow was about the same in the Sand Clay Hills and Mixed Brown Loam, $7.36 and $7.64, respectively, but lower in the Northeast Prairie, $5.16. Larger herds in the latter area probably accounted in part for the lower cost per cow.

The cost of marketing beef animals, including such items as hauling, commission fees, yardage, etc., amounted to an average of $107 per farm or 4 percent of the total cost of the enterprise. This item of cost was considerably lower on a per cow basis in the Mixed Brown Loam than in the other two areas, $1.85 compared to $3.39 in the Sand Clay Hills and $2.42 in the Northeast Prairie. The average per cow for all farms was $2.57.

Miscellaneous items such as veterinary fees and medicine, feed grinding, salt, etc., used in connection with the beef enterprise amounted to an average of $202 per farm or $4.87 per cow, and were about 8 percent of the total cost of the enterprise.

Returns. Total returns averaged $3,142 per farm or $75.53 per cow for all farms studied (Table 3). On the average, the production of beef accounted for 93 percent of the total returns and pasture credits the balance.

Although producers in the Mixed Brown Loam had the lowest returns per farm ($2,073 compared to $2,407 in the Sand Clay Hills and $5,289 in the Northeast Prairie), they had the highest returns per cow ($86.88 compared to $70.28 in the Northeast Prairie and $72.18 in the Sand Clay Hills). This was due to a greater volume of beef produced per cow to more pasture credits.

The difference between total returns and total cost as calculated here represents the return to the operator for capital invested in the enterprise and for management of the enterprise. Returns to investment per farm ranged from $297 in the Sand Clay Hills to $932 in the Northeast Prairie and averaged $629 for all farms studied.

Returns to investment per cow averaged $15.14. Producers in the Mixed Brown Loam had returns to investment more than twice as great as those in the Sand Clay Hills and about 50 percent greater than those in the Northeast Prairie ($18.61 compared to $8.88 and $12.38). The percentage return on capital invested was

4.78 in the Mixed Brown Loam, 2.51 in the Sand Clay Hills, and 2.95 in the Northeast Prairie. For all farms the percentage return to capital invested in the beef enterprise was 3.75.

Management Practices and Other Factors Influencing Profits Per Cow

All management practices affected to some extent returns to investment per cow. The selected practices and factors presented below are by no means the only ones which affect profits. Furthermore, the difference between returns to investment per cow for one group of producers and returns for another group can in no wise be construed as being entirely a result of the particular management practice or practices upon which the groups were selected. Selection of groups of farms upon the basis of the management practices presented below does, however, give some indication of the general level of management in the different groups. Differences in returns to investment must, therefore, be interpreted as difference resulting from a particular level of management in general rather than from the particular practice or practices upon which the groups were selected.

Herd Size. For the farms studied there was no consistent relationship between herd size and returns to investment per cow (Appendix Table 38). Any effect that this factor may have had on returns to investment per cow was offset by other factors or management practices.

Years in Beef Production. Ordinarily it is expected that producers having considerable experience with an enterprise will make larger profits per unit of output than those with less experience. For the year studied, there was no consistent relationship between the length of time operators had been producing beef commercially, and returns to investment per cow, however, producers having the most experience had slightly higher returns to investment per cow than producers having the least experience (Appendix Table 39).

Date of Calving. Most workers in the field of Animal Husbandry recommend that beef cows be bred to drop calves in the late winter in order to make maximum gains before the supply of cheap grazing begins to fail in the fall. However, during the year studied, there was no consistent relationship between date of calving and profit per cow (Appendix Table 40). Any effect the date of calving might have had on profits per cow was offset by the efficiency with which other management practices, such as feeding and grazing, were carried on. Also, late winter calving requires more of the operator's time during the calving period than it would if calves were dropped later, because of more unfavorable weather. On those farms where this additional attention is not forthcoming, late winter calving is likely to be less profitable than calving at a later date.

Quality of Cows. In a competitive market such as that which existed for beef brood cows during the year studied, the value of an animal should have reflected, with a fair degree of accuracy, the quality of the animal. Under the assumption that such was the case, the 139 farms studied were divided into four groups, using the value of brood cows per head as an index of quality, to determine the effect that quality of cows had on returns to investment per cow.

A comparison of costs and returns for the four groups showed that total returns for the group of producers having cows valued at less than $115 per head lacked $1 of covering costs per cow; producers having cows valued at $115-$125 per head had a return to investment of $5 per cow; and those having cows valued at $126-$154 per head and those having cows valued at $155 or more per head showed a return to investment of $18 and $17 per cow, respectively (Appendix Table 41).

Feeding Practices. From a study of individual farm record, it became apparent that producers having low returns to investment per cow were those who were feeding the more expensive feeds or large quantities of hand-fed feeds during the winter months.

Since feeding practices varied widely between farms, some means of measuring the different levels of feeding had to be devised if the effect of the level of feeding on return to investment per cow was to be studied. It is believed that feed cost serves the purpose very well. When all farms studied were divided into four groups on the basis of feed cost, the quantites fed per cow of each of the three classes of feeds (roughage, protein supplement, and other concentrates) increased with an increase in feed cost (Appendix Table 42).

A comparison of costs and returns for the four groups mentioned above showed a wide variation in returns to investment. Producers having the lowest feed cost per cow (under $15) had returns to investment amounting to $25 compared to a loss of $11 for those having the highest feed cost per cow ($35 and over). There was no significant difference in returns to investment for the two middle groups. Producers having feed costs of $15-$21 per cow had returns to investment of $15 while those having feed costs of $22-$34 had returns to investment of $14.

The above comparisons indicate that if profits from the beef enterprise are to be maximized feeding of the more expensive feeds or large quantities of hand-fed feeds through the winter months must be curtailed. It is not necessary and may even be undesirable to keep brood cows fat during the winter months. However, they should be kept in a thrifty condition. Professor Frank B. Morrison of Cornell University states that if mature beef cows go into the winter months in good flesh they may lose as much as 50 to 125 pounds in weight and still produce normal calves.[13]

Pasture Management. From a study of the individual farm records, it became apparent that in general those producers who had large acreages of the different types of pasture had lower returns to investment per cow than those who had smaller acreage. Also, there was an indication that those producers who had the more expensive pastures had lower returns to investment than those having the less expensive pastures.

Since there was such wide variation in pasture practices between farms, some means of measuring pasture management had to be devised if its effect on returns to investment was to be studied. It is believed that net pasture cost[14] per cow is the best means available for this purpose.

When the 139 farms studied were divided into four groups on the basis of net pasture cost, it was found that the acreage of improved permanent pastures per cow increased with an increase in net pasture cost (Appendix Table 43). Also, except for the fact that the first and the second group had the same acreage of temporary winter pasture, there was an increase in the acreage of temporary winter pasture per cow.

A comparison of costs and returns for these four groups showed that producers having the lowest net pasture cost per cow (under $8) had returns to investment of $26 compared to a loss of $10 for those having the highest net pasture cost ($26 and over). It is significant that a contributing factor to the higher returns to investment for the first group of producers was pasture credits amounting to $15 per cow with total pasture cost amounting to only $13 per cow.

There was little difference in returns

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[13] F. B. Morrison, **Feeds and Feeding,** the Morrison Publishing Company, Ithaca, New York, 21st Edition, p. 817.

[14] Annual pasture cost minus pasture credits for hay and seed.

to investment per cow for the two middle groups. Producers having a net pasture cost of $8-$15 per cow had returns to investment of $11 per cow, and those having a net pasture cost of $16-$25 per cow had returns to investment of $15 per cow.

The above comparison indicates that, with the present level of pasture management, large acreage per cow of the more expensive pastures result in considerably reduced profits from the beef enterprise. However, with good pasture management (saving hay and seed to reduce pasture costs and the proper utilization of the expensive pasture) the reverse might be true. For example, those producers saving seed or hay from pasture land had returns to investment per cow amounting to $17 per cow compared to $8 per cow for those producers not harvesting hay or seed from pasture land (Appendix Table 44).

Temporary winter pasture appears to be profitable if calves are carried through the winter and sold in the spring but unprofitable if all calves are sold in the fall. When farms having temporary winter pasture were divided into two groups on the basis of selling calves in the spring or not selling calves in the spring, a considerable difference in net returns per cow was noted. Producers having temporary winter pasture and selling calves in the spring had returns to investment per cow of $18 compared to $7 for the group having temporary winter pasture and not selling calves in the spring. Producers not having temporary winter pasture had returns to investment per cow of $11.

Health Practices. Information was secured from producers as to whether their beef cattle were sprayed for flies, treated for grubs, treated for internal parasites, or vaccinated for blackleg, Bangs, etc. It was realized that one of these practices might have been more important than others, but the number of practices carried out by each producer should give some indication of the overall level of health and sanitation practices on the individual farm.

Under the assumption that the general level of health and sanitation practices could be ascertained in this manner, the 139 farms studied were divided into four groups on the basis of the number of health or sanitation practices carried out and costs and returns for the four groups were compared. This comparisons showed a consistent relationship between the number of health and sanitation practices carried out and returns to investment per cow. Returns to investment per cow ranged from $5 for producers carrying out none of the above practices to $19 per cow for those carrying out three or more of these practices (Appendix Table 45).

The above comparisons indicate that strict adherence to the principles of good health and sanitation is necessary for the realization of maximum profits from the beef enterprise. Producers who do nothing about internal parasites, Bangs, etc., may expect reduced profits.

Combined Effect of Several Management Practices on Profit per Cow. The aforementioned comparisons indicated a need for good management in several phases of the beef enterprise if profits are to be increased. To determine the effect on returns to investment of different levels of management associated with a combination of several of these practices, all farms studied were first divided into two groups on the basis of value of brood cows. This grouping showed that producers having above average quality cows[15] had returns to investment of $18 per cow compared to $2 per cow for those having below average quality cows (Appendix Table 46).

To study the combined effect of quality of cows and feeding practices on returns, each of the above groups were next divided into two groups on the basis of feed cost. This grouping showed that producers having above average quality cows and below average feed cost had a return to investment of $33 per cow compared to a loss of $3 per cow for those having below average quality cows and above average feed cost.

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[15] See footnoes 1, 2, 3, and 4 in Appendix Table 45 for definition of this term and terms to follow.

In order to study the combined effect of quality of cows, feeding practices, and pasture management on return per cow, the group of farms having above average quality cows and below average feed cost and the group having below average quality cows and above average feed cost were further divided into two groups each on the basis of net pasture cost per cow. This grouping disclosed that producers having above average quality cows, below average feed cost, and below average net pasture cost had a return to investment amounting to $47 per cow in contrast to a loss of $6 per cow for those having below average quality cows, above average feed cost, and above average net pasture cost.

Finally, in order to determine the combined effect of quality of cows, feeding practices, pasture management, and the level of health and sanitation practices on returns per cow, the group of farms having above average quality cows, below average feed cost, and below average net pasture cost, and the group having below average quality cows, above average feed cost, and above average net pasture cost were again divided into two groups each on the basis of the number of health and sanitation practices carried out. This grouping showed even greater differences in returns to investment per cow. Producers having above average quality cows, below average feed cost, below average net pasture cost and above average health and sanitation practices had returns to investment per cow amounting to $55. Producers having below average quality cows, above average feed cost, above average net pasture cost, and below average health and sanitation practices had a loss of $25 per cow.

These comparisons indicate that although profits from the beef enterprise may be increased by better management in individual phases of the beef enterprise, maximum profits can be obtained only through the utilization of good practices in all phases of the enterprise.

SUMMARY AND CONCLUSIONS

It is especially important that an expanding industry, such as the beef cattle industry in Mississippi, have at hand information as to the usual management practices, resources used, and the costs and returns involved. It is helpful also if weaknesses in the usual management practices can be pointed out and suggestions made as to how these weaknesses can be corrected. It was with these thoughts in mind that this study was undertaken by the Mississippi Agricultural Experiment Station.

Data for the study were obtained by personal interview with 139 beef producers in Northeast and East Central Mississippi Insofar as was possible, all producers who had 10 or more grown cows or who sold 10 or more beef animals during the year studied were interviewed. However, schedules were not obtained from producers who were also cattle traders.

Three Soil Areas

In order to determine the effect of soil area on practices used and on costs and returns, the three major soil areas, the Sand Clay Hills, Mixed Brown Loam, and Northeast Prairie were studied separately. Beef cattle farms in the latter area averaged about 1,100 acres in size compared to about 500 acres in the other two areas. All beef cattle farms studied averaged about 650 acres compared to less than 140 acres for the average operating unit in this section of the state. A relatively large acreage of land is usually required where major emphasis is placed on the beef enterprise.

On the farms studied, a smaller proportion of the total land area was woodland in the Northeast Prairie than in the other two areas, 21 percent compared to 45 percent in the Sand Clay Hills and 50 percent in the Mixed Brown Loam. About three-fourths of all woodland was grazed and about one-half of all open land was used as open permanent pasture. The principal crops grown were: cotton, corn, hay, and temporary winter pasture.

Tractors were used on about three-fourths of the farms studied and mules on practically all farms. Producers in the Sand Clay Hills had less equipment for harvesting hay and seeds than producers in the other two areas. The general barn was the only building used in connection with the beef enterprise on slightly over one-half of the farms studied.

On the average, there were 3.4 members of the operator's family on the farm. Over one-half of this number were between 18 and 60 years of age in each of the three major areas. In addition to the family labor force, most farms had croppers, wage hands, or both. About three-fourths of the cotton and about one-half of the corn was worked by croppers.

Average 41.6 Cows Per Farm

Beef cows and grown heifers numbered 75.2 per farm in the Northeast Prairie, 33.4 in the Mixed Brown Loam, and 23.9 in the Sand Clay Hills. The average for all areas studied was 41.6. Other livestock such as hogs, sheep, and dairy cattle, of commercial importance were found on about half of the farms studied. In general, hogs, were the most common enterprise; but in the Northeast Prairie, sheep were more prevalent than hogs and dairy cattle almost as prevalent.

Except for temporary winter pasture, which averaged .5 acres per cow for each of the three areas, there was considerable variation in the acreage of the different types of pasture per cow. Improved permanent pasture per cow averaged 2.0, 1.6, and 2.9 acres; unimproved permanent pasture 1.7, 2.1, and 2.3 acres; and woodland pasture 3.6, 4.5, and 1.3 acres for the Sand Clay Hills, Mixed Brown Loam, and Northeast Prairie, respectively. There was no temporary summer pasture in the Mixed Brown Loam and only an insignificant amount in the other areas.

Producers in the Mixed Brown Loam had less improved permanent pasture per cow, but on the acreage provided, a more thorough job of improvement was done. For all farms studied, 17.3 percent of the improved permanent pasture was improved by land preparation, fertilization, and seeding all on the same plot; 45.8 percent by one or two of these practices; and 36.9 percent by mowing.

Half Had Winter Pastures

Temporary winter pasture was provided for the beef enterprise on 64 of the 139 farms studied. The predominant type of winter pasture was oats alone or oats in combination with legumes in the Sand Clay Hills and Mixed Brown Loam and wild winter peas in the Northeast Prairie. Producers in the Mixed Brown Loam did a more thorough job of land preparation and used heavier applications of fertilizers on land used for temporary winter pasture than did producers in the other two areas.

Grazing on temporary winter pasture was begun on the average the second week of December and continued until the latter half of March. During this period temporary winter pasture was grazed about 85 percent of the days. The usual grazing practice was to leave cattle on the pasture 24 hours per day when weather permitted .

Third Harvested Hay or Seed

Almost one-third of the producers interviewed harvested hay or seed or both from improved pasture and/or temporary winter pasture used by the beef enterprise. Seeds harvested were: oats, crimson clover, White Dutch clover, wild winter peas, sericea lespedeza, fescue and vetch. Producers in the Mixed Brown Loam harvested larger amounts of the more valuable seed per acre than did producers in the other two areas.

The feeding of hand-fed feeds usually began the first week of December and continued until the latter half of March. For all farms studied, roughage per cow averaged .8 tons and concentrates 360 pounds, with producers in the Northeast Prairie feeding the largest quantity of roughage and the smallest quantity of concentrates. The feeding pattern was protein supplement and grass hay in the Northeast Prairie and legume hay and corn in the Mixed Brown Loam. Producers in the Sand Clay Hills had no clearly defined feeding pattern.

15.8 Hours Labor Per Cow

Labor used per cow was lowest in the Northeast Prairie, 12.9 hours compared to 18.4 hours in the Sand Clay Hills and 19.1 hours in the Mixed Brown Loam. The average for all areas studied was 15.8 hours of which 56 percent was for daily chores, 35 percent for feeding and 9 percent for other jobs such as dehorning, castrating, etc.

Pure-bred bulls and grade cows were the usual breeding stock. However, in some cases the bull and a part or all of the cows were registered. On the average, brood cows were about five-eighths beef blood. As a rule the bull was pastured with the cows and, following the natural calving pattern, slightly over three-fourths of the calves were born from January through May. The calving percentage averaged 78 for all farms.

Almost three-fourths of the calves sold were sold during the three-month period August - October in the Mixed Brown Loam and Northeast Prairie, but in the Sand Clay Hills less than one-half were sold during this period. The sale of cows was concentrated in the same period in the Northeast Prairie, but in April and May in the Mixed Brown Loam. Cow sales were scattered throughout the year in the Sand Clay Hills.

Few Calves Purchased

About 3 percent of the calves raised were purchased from other producers. These purchases were concentrated in the three-month period November - January in the Sand Clay Hills. In the other two areas calf purchases were concentrated in the spring months and in the fall months. Cow purchases were concentrated in the spring months in the Sand Clay Hills and Mixed Brown Loam, but in the late summer and early fall in the Northeast Prairie.

There was little overall difference between areas in the level of health and sanitation practices carried out, and the level was rather low on most farms studied. Death losses averaged 3.0 percent for cows and 4.5 percent for calves. The Mixed Brown Loam had the highest and the Sand Clay Hills the lowest death loss for both cows and calves. Abortions averaged 2.1 percent and were highest in the Northeast Prairie and lowest in the Mixed Brown Loam.

The overall production of beef per cow averaged 335 pounds, 387 pounds and 334 pounds for the Sand Clay Hills, Mixed Brown Loam, and Northeast Prairie, respectively. About 90 percent of the beef produced was sold and calves accounted for about two-thirds of the total volume sold.

$404 Investment Per Cow

Because of the relatively large acreage of land required and because of the high investment required in breeding stock, total investment in the beef enterprise was relatively high, an average of $16,841 per farm or $404 per cow. The breeding herd accounted for 41 percent of the total, land for 54 percent and buildings 5 percent.

Total cost per farm excluding a charge for interest on investment, ranged from $1,628 in the Mixed Brown Loam to $4,357 in the Northeast Prairie and averaged $2,513. On a per cow basis, total cost was highest in the Mixed Brown Loam and lowest in the Sand Clay Hills, $68.27 compared to $63.30. Feed and pasture were the major cost items.

Returns per farm ranged from $2,073 in the Mixed Brown Loam to $5,289 in the Northeast Prairie. In contrast, returns per cow were highest in the Mixed Brown Loam and lowest in the Northeast Prairie, $86.88 compared to $70.28.

3.75 Percent Return

Returns to investment per farm ranged from $297 in the Sand Clay Hills to $932 in the Northeast Prairie. On a per cow basis, returns to investment were more than twice as great in the Mixed Brown Loam as in the Sand Clay Hills and about 50 percent greater than in the Northeast Prairie ($18.61 compared to $8.88 and $12.38). Percent return to capital invested ranged from 2.51 in the Sand Clay Hills to 4.71 in the Mixed Brown Loam and averaged 3.75 for all farms studied.

All management practices affected to some extent returns to investment per cow. Therefore, when all farms studied are grouped according to some particular practice or practices, differences in returns to investment per cow must be interpreted as differences attributable to differences in levels of management in general rather than to the particular practice or practices upon which the grouping was based.

When all farms studied were separated into four groups on the basis of herd size, no consistent relationship was found between herd size and returns to investment per cow. The same was true regarding the date of calving. Any effect the date of calving might have had on profits per cow was affected by the efficiency with which other management practices, such as feeding and grazing, were carried out. While there was no consistent relationship between the length of time farm operators had been producing beef commercially and returns to investment per cow, producers having the most experience had slightly higher returns to investment per cow than producers having the least experience.

A division of all farms studied into four groups on the basis of quality of cows (value per head used as an index of quality) showed that producers having cows valued at less than $115 per head had a return to investment per cow of -$1 compared to $5, $18, and $17, for those having cows valued at $115-$125, $126-$154, and $155 or more.

Heavy feeding and the feeding of expensive feeds were associated with low returns to investment. When all farms studied were divided into four groups on the basis of level of feeding (feed cost per cow used as an index of the level of feeding), returns to investment per cow ranged from $25 for producers having the lowest feed cost to a loss of $11 for those having the highest feed cost.

Poor pasture management was also associated with low returns to investment per cow. When all farms studied were divided into four groups on the basis of level of pasture management (net pasture cost per cow used as an index), it was found that returns to investment per cow ranged from $26 for producers having the lowest net pasture cost to a loss of $10 for those having the highest.

This comparison indicated that with the present level of pasture management large acreages per cow of the more expensive pastures result in considerably reduced profits from the beef enterprise. However, with good management (saving hay or seeds to reduce grazing costs and the proper utilization of experiment pasture) the reverse might be true. For example, producers saving hay and seed from pasture land had higher profits per cow than producers not harvesting hay and seed from their pasture land. Producers having temporary winter pasture had lower profits than producers not having temporary winter pasture on those farms where calves were sold in the fall; however, they had higher profits on those farms where calves were carried through the winter and sold in the spring.

The foregoing comparisons indicated a need for good management in several phases of the beef enterprise if profits are to be maximized. To show the combined effect of good management in more than one phase of the enterprise, the following comparison was made. Producers having better than average quality cows, below average feed cost, below average pasture cost and above average health and sanitation practices had a return to investment of $55 per cow as compared to a loss of $25 per cow for those producers having below average quality cows, above average feed cost, above average pasture cost and below average health practices.

This study showed that on the average returns from the beef enterprise were relatively low. However, relatively high returns were obtained on those farms where the better management practices were used. Therefore, if maximum profits are to be obtained, good management must be practiced in all phases of the enterprise. In particular, the producer should give special attention to (1) improving quality of brood cows by using purebred beef bulls, selecting with more care replacement heifers, buying better replacements, etc.; (2) keeping feed cost low by reducing the quantities of hand-fed feeds and utilizing the less expensive feeds whenever possible, and yet keep brood cows in a thrifty condition; (3) keeping grazing costs low by saving hay or seed or both from pasture land, stocking pastures at the correct rate, and utilizing expensive temporary winter pastures for calves only; (4) maintaining the beef herd in a healthy condition

APPENDIX I

Methods Used in Calculating Investment, Costs, and Returns

A. Investment.

1. **Beef Herd.** The average number of each class of beef animals was calculated from the number on hand at the beginning and at the end of the year. Investment in the beef herd was determined from the average number of each class of beef animals and producer estimates of the value of each class at the end of the year. An allowance was made on each farm for changes in weight of each class of animal.

2. **Land.** Acreage of pasture land used by the beef herd was calculated by prorating the total acreage, on the basis of grazing secured, between the beef herd and other livestock. Investment in pasture land was based on the number of acres used by the beef herd and producer estimates of value per acre, which included the value of fences. Only one-half of the value of land double-cropped was included in the investment. Woodland pasture was valued for grazing purposes only.

3. **Buildings.** It was assumed that the average investment in buildings would approximate one-half of the replacement cost. Investment in buildings was based on this assumption and on producer estimates of replacement cost. Investment in buildings used jointly with other livestock was prorated on the basis of the proportion used by the beef herd.

B. Costs

1. **Feed.** Feed costs were based on producer estimates of quantities fed and the average price of each kind of feed. The price used for home-grown feeds was the price paid

farmers during the harvest season.

2. **Pasture.** Pasture cost was based on the acreage used by the beef enterprise and the annual cost per acre of each type of pasture. In calculating pasture costs, labor cost was calculated at the prevailing wage rate of 40 cents per hour; machinery cost was based on farm management cost studies; fencing cost was based on producer estimates as to the materials, labor, and equipment used and prevailing prices; and seed and fertilizer costs were calculated by using average prices for the year studied and producers information as to quantities used.

In calculating the total cost of improved permanent pasture, the total cost of improvements made was calculated on the basis of July 1949-June 1950 prices regardless of the year in which the improvement was made. Because of wide differences in P.M.A. payment rates in different years and in the different counties, no deduction from total pasture cost for these payments was made.

Upon the recommendations of agronomists, the annual charges for seed, fertilizer, and land preparation for improved permanent pasture were calculated as follows: (1) seed, one-tenth of the total cost; (2) land preparation except applying fertilizer, one-tenth of the total cost; and (3) cost of fertilizer and the cost of applying fertilizer was calculated as follows: the total cost of nitrogen was charged to the year applied; 40 percent of the total cost of phosphate, potash and basic slag was charged to the year applied, 40 percent to the following year and 20 percent to the third year; and 20 percent of the total cost of lime was charged to each of the first four years after its application, 10 percent to the fifth year and 10 percent to the sixth year. In addition, the annual cost of improved permanent pasture included mowing and fencing.

3. **Buildings.** Building cost included depreciation and repairs. The annual charge for depreciation was calculated by the straight-line method, charges for repairs were based on farm management cost studies and were calculated at 3 percent of replacement cost.

4. **Labor.** Labor cost was based on producer estimates of time spent on the beef herd and the prevailing wage rate (40 cents per hour).

5. **Marketing.** Marketing cost was based on producer information as to commission fees and other marketing costs.

6. **Miscellaneous.** Miscellaneous cost was based on producer information as to these costs or as to the quantities of miscellaneous items used and the average price of these items.

C **Receipts**

1. **Beef Production.** Receipts from the production of beef were calculated by adding the value of animals sold and animals killed for food and inventory changes and subtracting the value of animals purchased. In calculating the value of inventory changes, increases or decreases in inventory were valued at prices per pound prevailing at the end of the year.

2. **Pasture Credits.** Pasture credits were based on producer estimates as to the quantity of hay and seeds harvested from pasture land charged to the beef enterprise and prevailing prices for these items. The average price received for these items was discounted by amount equal to the cost of harvesting.

D. **Investment, Cost, and Returns for Different Management Practices.** All items presented for different groups in connection with different management practices are simple averages.

APPENDIX II

Statistical Tables

Appendix Table 1. Land use, 139 beef cattle farms, Northeast and East Central Mississippi July 1949-June 1950.

Item	Soil area			Average all areas[1]
	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	
			Acres	
Owned	458	483	1,055	647
Rented in	36	4	53	28
Rented out	4	1	31	13
Operated	490	486	1,077	662
Cropland	131	142	352	201
Improved permanent pasture	73	42	257	117
Unimpproved permanent pasture	61	57	226	101
Woodland pasture				
Woodland				
Farmstead and other			----	
Number farms				

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge and Flatwoods soil areas.

Appendix Table 2. Cropping pattern, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil areas			Average all areas*
	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	
			Acres	
Cotton	27	32	66	44
Corn	54	67	80	72
Oats for grain only	3	6	11	7
Hay	20	25	133	48
Temporary winter pasture	19	15	49	24
Temporary summer pasture	1	---	**	1
Other crops	3	4	16	6
Idle cropland	16	7	20	16
Cropland double cropped	11	13	21	16
Pasture land double cropped	1	1	2	1

*Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

**Less than 0.5 acres.

Appendix Table 3. Power and equipment used, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil areas			Average all areas[1]
	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	
	Percentage of farms having			
Workstock	91	95	93	94
Tractor	71	78	86	78
Disc	84	80	86	84
Breaking plow	76	63	79	73
Cultipacker	11	15	38	22
Grain drill	22	32	34	28
Lime spreader	35	29	48	37
Mower	85	88	97	89
Rake	67	78	86	77
Baler	24	37	48	34
Combine	5	24	45	22
Silage cutter	11	7	7	9

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Appendix Table 4. Buildings used in connection with the beef enterprise, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil area			Average all areas[1]
	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	
	Percentage of farms using			
General barn	88	90	66	83
Hay barn	29	20	45	32
Loafing barn	5	7	....	4
Temporary shelter	2	....	14	4
Other grain storage	7	2	3	4
Silo	1	2	7	4

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Appendix Table 5. Total replacement cost of buildings per farm and replacement cost to the beef enterprise per farm, 139 beef cattle farms Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil areas			Ave. all areas[1]	Soil areas			Ave. all areas[1]
	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie		Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	
	Total replacement cost (dol.)				Replacement cost to beef (dol.)			
General barn	1,685	2,002	2,164	1,943	944	1,034	1,398	1,140
Hay barn	370	210	657	446	334	204	524	390
Other buildings	88	146	141	118	74	146	136	112
Total	2,143	2,358	2,962	2,507	1,352	1,384	2,058	1,642

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Appendix Table 6. Building cost per farm and per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil areas			Ave. all areas[1]	Soil areas			Ave. all areas[1]
	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie		Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	
	Dollars per farm				Dollars per cow			
Depreciation	62	59	98	77	1.86	2.49	1.30	1.85
Repairs	40	42	62	50	1.21	1.74	.82	1.19
Total[2]	102	101	160	127	3.07	4.23	2.12	3.04

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

[2] When 5 percent interest is charged on the investment in buildings, the total cost per farm and per cow is as follows for the Sand Clay Hills, Mixed Brown Loam, Northeast Prairie, and average for all areas, respectively: per farm: $136, $136, $211, and $168; per cow: $4.07, $5.68, $2.82, and $4.04.

Appendix Table 7. Age and sex distribution of family labor force, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Age group	Soil area: Sand Clay Hills	Mixed Brown Loam	North-east Prairie	Average all areas[1]
	Percent			
Under 9:				
Males	5	7	13	7
Females	3	4	1	3
Total	8	11	14	10
9-12:				
Males	4	2	2	3
Females	3	5	1	3
Total	7	7	3	6
13-17:				
Males	4	5	4	4
Females	8	5	2	6
Total	12	10	6	10
18-59:				
Males	31	33	33	32
Females	31	22	32	28
Total	62	55	65	60
60-69:				
Males	2	3	6	4
Females	2	5	4	4
Total	4	8	10	8
Over 70:				
Males	4	6	2	4
Females	3	3	------	2
Total	7	9	2	6
All ages:				
Males	50	56	60	54
Females	50	44	40	46
Total	100	100	100	100
Number of workers per farm	3.7	3.7	2.9	3.4

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Appendix Table 8. Age of operators, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Age group	Soil area: Sand Clay Hills	Soil area: Mixed Brown Loam	Soil area: North-east Prairie	Average all areas[1]
		Percent		
20-29	5	------	3	3
30-39	15	5	21	13
40-49	29	32	28	29
50-59	29	32	24	31
60-69	5	12	17	11
70 and over	17	19	7	13
Total	100	100	100	100

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas

Appendix Table 9. Hours of labor used per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	J	F	M	A	M	J	J	A	S	O	N	D	Total
Sand Clay Hills:													
Daily chore	.9	.8	1.0	1.0	.9	.9	.9	.9	.9	1.0	.9	.9	11.0
Feeding	1.5	1.4	1.2	.3	----	----	----	----	----	----	.4	1.1	5.9
Other	.1	.1	.1	.1	.1	.2	.2	.2	.1	.1	.1	.1	1.5
Total	2.5	2.3	2.3	1.4	1.0	1.1	1.1	1.1	1.0	1.1	1.4	2.1	18.4
Mixed Brown Loam:													
Daily chore	.8	.7	.9	.9	.9	.8	.9	.9	.8	.8	.8	.8	10.0
Feeding	1.8	1.6	1.4	.2	----	----	----	----	----	.1	.4	1.2	6.7
Other	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	2.4
Total	2.8	2.5	2.5	1.3	1.1	1.0	1.1	1.1	1.0	1.1	1.4	2.2	19.1
Prairie:													
Daily chore	.6	.5	.6	.6	.7	.7	.7	.7	.7	.7	.6	.6	7.7
Feeding	1.2	1.0	1.0	.1	----	----	----	----	----	----	.1	.5	3.9
Other	.1	.1	.1	.2	.1	.1	.1	.1	.1	.1	.1	.1	1.3
Total	1.9	1.6	1.7	.9	.8	.8	.8	.8	.8	.8	.8	1.2	12.9
Average all areas:													
Daily chore	.7	.6	.7	.7	.8	.8	.8	.8	.8	.8	.7	.7	8.9
Feeding	1.5	1.4	1.2	.2	----	----	----	----	----	----	.3	.9	5.5
Other	.1	.1	.1	.2	.2	.1	.1	.1	.1	.1	.1	.1	1.4
Total	2.3	2.1	2.0	1.1	1.0	.9	.9	.9	.9	.9	1.1	1.7	15.8

Appendix Table 10. Beef cattle numbers, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	On hand July 1, 1949	Born	Purchased	Home use	Sold	Died	On hand July 30, 1950	Inventory change	Average of inventories[1]
					Number head				
Sand Clay Hills:									
Cows and heifers, 2+	31.9	—	4.2	—	4.5	1.0	34.8	+ 2.9	33.4
Heifers, 1-2	3.7	—	.6	—	—	—	5.9	+ 2.2	4.8
Bulls, 1+	1.8	—	.1	—	.4	—	1.5	— .3	1.6
Steers, 1+	.2	—	2.3	—	2.2	—	1.1	+ .9	.6
Calves, 1-	20.6	25.7	.8	.2	18.2	1.0	21.0	+ .4	20.8
Total	58.2	25.7	8.0	.2	25.3	2.0	64.3	+ 6.1	61.2
Mixed Brown Loam:									
Cows and heifers, 2+	22.0	—	1.9	—	1.1	1.0	25.8	+ 3.8	23.9
Heifers, 1-2	3.2	—	1.7	—	.3	—	5.5	+ 2.3	4.4
Bulls, 1+	1.2	—	.2	—	.1	—	1.5	+ .3	1.4
Steers, 1+	.8	—	.2	—	1.4	—	1.1	+ .3	1.0
Calves 1-	15.7	19.2	.9	.6	10.0	1.3	17.1	+ 1.4	16.3
Total	42.9	19.2	4.9	.6	12.9	2.3	51.0	+ 8.1	47.0
Prairie:									
Cows and heifers, 2+	71.6	—	7.6	—	5.0	2.4	78.9	+ 7.3	75.2
Heifers, 1-2	7.3	—	.7	—	.3	—	7.4	+ .1	7.4
Bulls, 1+	3.3	—	.3	—	.3	—	3.6	+ .3	3.4
Steers, 1+	3.2	—	—	—	3.1	—	3.1	— .1	3.2
Calves, 1-	39.8	59.9	2.0	.7	45.1	2.9	42.7	+ 2.9	41.2
Total	125.2	59.9	10.6	.7	53.8	5.3	135.7	+10.5	130.4
Average all areas:									
Cows and heifers, 2+	39.6	—	4.3	—	3.7	1.3	43.6	+ 4.0	41.6
Heifers, 1-2	4.4	—	1.6	—	.3	—	6.8	+ 2.4	5.6
Bulls, 1+	2.0	—	.3	—	.4	—	2.1	+ .1	2.0
Steers, 1+	1.0	—	.9	—	2.0	—	1.7	+ .7	1.4
Calves, 1-	24.2	32.6	1.1	.4	22.4	1.4	25.9	+ 1.7	25.0
Total	71.2	32.6	8.2	.4	28.8	2.7	80.1	+ 8.9	75.6

[1] July 1, 1949 and July 1, 1950.

Appendix Table 11. Percentage of specified animals sold by months, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	J	F	M	A	M	J	J	A	S	O	N	D	Total
Cows and heifers over 2 years:													
Sand Clay Hills	2.4	11.8	25.1	------	17.1	4.3	11.8	2.4	3.3	4.3	14.2	3.3	100.0
Mixed Brown Loam	4.7	4.7	7.0	20.8	18.5	7.0	2.3	7.0	7.0	9.3	7.0	4.7	100.0
Northeast Prairie	------	5.9	7.4	------	------	2.9	------	35.3	23.5	5.9	19.1	------	100.0
Average all areas[1]	1.9	8.6	16.5	5.1	12.4	6.5	9.7	8.6	10.2	4.9	13.2	2.4	100.0
Calves under 1 year:													
Sand Clay Hills	1.3	3.8	3.8	5.9	7.0	13.0	1.9	18.4	15.2	8.8	15.6	5.3	100.0
Mixed Brown Loam	8.3	.4	1.4	1.7	4.9	------	3.5	16.3	22.6	32.2	3.5	5.2	100.0
Northeast Prairie	------	------	9.4	------	------	.2	------	20.7	36.9	16.3	8.6	7.9	100.0
Average all areas[1]	1.9	1.3	5.1	2.9	3.1	4.8	1.2	21.0	27.9	16.1	9.7	5.0	100.0

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Table 13. Percentage of animals purchased by month, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	J	F	M	A	M	J	J	A	S	O	N	D	Total
Cows and heifers over 2 years:													
Sand Clay Hills	7.7	10.4	.7	2.0	1.2	5.6	5.1	5.1	6.9	3.4	36.7	15.2	100.0
Mixed Brown Loam	16.6	19.8	1.5	33.4	------	------	9.1	------	3.0	3.0	13.6	------	100.0
Northeast Prairie	27.2	4.5	5.5	10.0	4.1	.5	------	10.9	------	11.4	10.0	15.9	100.0
Average all areas[1]	15.5	8.2	2.6	8.6	2.1	2.6	3.1	8.6	9.4	6.3	20.8	12.2	100.0
Heifers, 1-2 years:													
Sand Clay Hills	3.9	12.7	------	5.9	8.8	------	26.6	------	6.9	12.7	12.7	9.8	100.0
Mixed Brown Loam	------	18.3	46.6	------	------	------	------	11.7	6.7	6.7	10.0	------	100.0
Northeast Prairie	------	------	------	57.1	------	------	------	------	23.8	------	14.3	4.8	100.0
Average all areas[1]	.8	8.7	20.8	7.9	13.0	11.3	5.1	4.0	10.4	8.1	7.5	2.4	100.0
Bulls:													
Sand Clay Hills	25.0	25.0	------	------	------	12.5	------	12.5	------	------	------	25.0	100.0
Mixed Brown Loam	------	60.0	------	------	------	------	------	20.0	------	20.0	------	------	100.0
Northeast Prairie	10.0	40.0	10.0	------	------	10.0	------	------	10.0	10.0	------	10.0	100.0
Average all areas[1]	7.4	33.3	11.1	------	------	7.4	------	7.4	7.4	7.4	3.7	14.9	100.0
Steers:													
Sand Clay Hills	4.0	7.9	------	------	------	------	23.0	13.5	7.9	19.8	23.9	------	100.0
Mixed Brown Loam	------	------	------	------	------	------	------	------	------	50.0	50.0	------	100.0
Northeast Prairie	------	------	------	------	------	------	------	------	------	------	------	------	100.0
Average all areas[1]	3.7	7.4	------	------	------	------	21.2	12.5	11.0	22.1	22.1	------	100.0
Calves under 1 year:													
Sand Clay Hills	23.7	------	4.8	------	------	2.4	------	2.4	------	------	16.7	50.0	100.0
Mixed Brown Loam	3.1	17.4	3.1	14.5	3.1	3.1	3.1	31.7	3.1	11.6	3.1	3.1	100.0
Northeast Prairie	1.8	1.8	12.3	19.2	33.2	1.8	1.8	3.5	1.8	19.2	1.8	1.8	100.0
Average all areas[1]	7.8	5.9	5.2	11.7	13.0	2.6	1.3	9.1	13.0	9.7	5.9	14.8	100.0

[1] Includes 14 farms in the Brown Loam, Northeast Highlands Pontotoc Ridge, and Flatwoods soil areas.

Appendix Table 12. **Ages at which cows and calves were sold, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.**

Item	Soil area			Average all areas[1]
	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	
	Percent of total			
Age of cows sold (years):				
Under 4	3.6	7.3	4.1	6.0
4 - 5	10.0	14.6	27.6	14.7
6 - 7	52.3	22.0	9.7	36.5
8 - 9	31.7	46.3	53.8	37.4
10 or over	2.4	9.8	4.8	5.4
Total	100.0	100.0	100.0	100.0
Age of calves sold (months):				
Under 4	1.1	3.2	......	1.4
4 - 5	22.4	27.9	5.7	17.9
6	49.9	33.4	43.4	40.0
7 - 8	17.3	15.1	40.0	25.6
9 - 11	9.3	20.4	10.9	15.1
Total	100.0	100.0	100.0	100.0
Average weight of calves sold[2]	352	423	389	383

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

[2] The average weight of calves sold on individual farms ranged from 200 pounds to 630 pounds

Appendix Table 14. **Percentage of calves born during each month and percent calf crop, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.**

Item	Soil area			Average all areas[1]
	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	
January	5.0	8.9	17.3	11.3
February	10.6	11.6	11.2	11.9
March	18.5	24.8	22.6	21.1
April	29.7	18.4	14.1	19.7
May	16.9	17.7	9.4	14.0
June	6.3	6.8	3.5	5.7
July	2.1	1.9	1.1	1.5
August	2.5	.8	2.6	2.1
September	2.2	.4	1.7	1.9
October	2.4	1.2	1.6	1.9
November	2.1	2.6	2.1	2.1
December	1.7	4.9	12.8	6.8
Total	100.0	100.0	100.0	100.0
Percent calf crop	77.0	81.0	80.0	78.0

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Appendix Table 15. Health practices, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Health practices	Soil areas: Sand Clay Hills	Soil areas: Mixed Brown Loam	Soil areas: Northeast Prairie	Average all areas[1]
	Percent of producers			
Treating for grubs	22	34	17	24
Treating for internal parasites	16	17	7	17
Spraying for flies	67	63	55	63
Vaccinating for:				
Blackleg	75	61	90	75
Septicemia	31	15	38	26
Bangs	5	5	10	7
Pinkeye	5	----	----	4
Testing for:				
Bangs	11	12	10	14
T. B.	----	2	---	1

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Table 16. Death losses and other factors, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil area: Sand Clay Hills	Soil area: Mixed Brown Loam	Soil area: Northeast Prairie	Average all areas[1]
	Percent			
Death losses:				
Cows	2.9	4.4	3.2	3.0
Heifers	.8	----	.5	.5
Bulls	----	1.8	----	.7
Steers	----	5.0	----	2.1
Calves	4.0	7.0	4.8	4.5
All animals	3.1	5.0	3.5	3.4
Abortions[2]	1.6	.4	3.0	2.1

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

[2] Given as a percentage of the average number of cows.

Appendix Table 17. Beef production per farm, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil area				Soil area			
	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Av. all areas[1]	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Av. all areas[1]
	Liveweight (pounds)				Value (dollars)			
SALES:								
Cows & heifers, 2+	3,205	836	3,925	2,725	535	138	620	463
Heifers, 1-2	24	132	231	167	4	24	42	35
Bulls, 1+	340	154	281	295	71	31	47	68
Steers, 1+	1,384	931	2,090	1,263	254	174	374	231
Calves, 1-	6,405	4,211	17,574	8,576	1,406	869	3,623	1,819
Total	11,358	6,264	24,100	13,026	2,270	1,236	4,706	2,616
INCREASE IN INVENTORY:								
Cows & heifers, 2+	2,164	2,938	6,181	3,355	387	538	1,174	644
Heifers, 1-2	1,206	1,181	—49	1,182	236	235	—10	247
Bulls, 1+	—45	281	546	238	—11	70	149	64
Steers, 1+	508	147	—280	259	102	36	—59	55
Calves, 1-	19	515	700	527	4	113	168	128
Total	3,852	5,062	7,098	5,561	718	992	1,422	1,138
HOME USE:								
Steers, 1+	25	..	24	15	4	....	5	3
Calves, 1-	101	263	285	190	21	52	57	39
Total	126	263	309	205	25	52	62	42
PURCHASED:								
Cows & heifers, 2+	2,641	1,161	5,322	2,850	457	230	1,094	547
Heifers, 1-2	268	776	305	622	56	145	58	137
Bulls, 1+	104	102	237	171	28	27	97	60
Steers, 1+	988	85	....	416	176	12	....	73
Calves, 1-	160	217	506	270	22	35	109	55
Total	4,161	2,341	6,370	4,329	739	449	1,358	872
NET PRODUCTION:[2]								
Cows & heifers, 2+	2,728	2,613	4,783	3,230	465	446	700	560
Heifers, 1-2	962	537	—123	727	184	114	—26	145
Bulls, 1+	191	333	590	362	32	74	99	72
Steers, 1+	929	993	1,834	1,121	184	198	320	216
Calves, 1-	6,365	4,772	18,053	9,023	1,409	999	3,739	1,931
Total per farm	11,175	9,248	25,137	14,463	2,274	1,831	4,832	2,924
Total per cow	335	387	334	348	68.19	76.61	64.21	70.29

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

[2] Sales plus increase in inventory, plus home use, less purchase .

Appendix Table 18. Other livestock production, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Percent of farms having specified enterprise[1]	Average number of specified animals per farm having
Hogs:		
Sand Clay Hills	22	57
Mixed Brown Loam	55	48
Northeast Prairie	30	72
Average all areas[2]	33	55
Sheep:		
Northeast Prairie	46	37[3]
Average all areas[2]	13	37[3]
Dairy cows:		
Sand Clay Hills	3	12
Mixed Brown Loam	5	18
Northeast Prairie	24	35
Average all areas[2]	11	32

[1] Of commercial importance. Hogs 10 or more sold; sheep, 10 or more ewes or 10 or more lambs sold; and dairy cattle 10 or more cows milked.

[2] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

[3] Sheep sold.

Appendix Table 19. Land preparation, fertilization, and seeding practices ,all improved permanent pasture, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

	Percentage of total acreage covered				Times over or rate when performed			
	Soil area				Soil area			
Item	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	Average all areas[1]	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	Average all areas[1]
Land preparation:								
Discing	26.7	39.6	20.1	23.0	2.01	2.14	2.68	2.30
Breaking	4.1	13.0	6.0	5.2	1.00	1.02	1.33	1.18
Harrowing	15.6	29.4	21.5	18.0	1.42	1.32	2.28	1.93
Cultipacking	3.2	22.0	7.9	8.0	1.00	1.14	1.03	1.19[2]
Fertilizing	77.5	61.1	50.9	54.9	1.26	1.26	1.50	1.33
Limeing	24.2	15.4	8.4	14.5	1.00	1.33	1.00	1.03
Seeding	19.5	41.4	35.9	28.1	1.36	1.16	1.14	1.19
Mowing	75.6	85.6	92.6	88.6	1.69	1.76	1.72	1.87[3]
Fertilization:								
Lime	24.2	15.4	8.4	14.5	1,604	3,757	2,029	1,953
Basic slag	28.3	56.2	7.6	20.4	792	1,356	895	1,244
Mixed fertilizer	6.7	.5	.3	1.8	155	300	1,000	215
Nitrogen (N)	1.5	1.2	2.8	1.8	44	44	17	24
Phosphate (P_2O_5)	59.6	26.8	47.7	42.5	84	124	100	95
Potash (K_2O)	28.4	30.6	9.2	15.3	67	59	70	63
Seeding:								
Dallis grass	9.3	11.2	1.3	4.3	10	14	19	12
Lespedeza	8.0	14.7	20.5	13.7	19	18	30	26
White Dutch clover	10.7	23.7	2.5	7.3	6	6	12	6
Ladino clover	2.2	.4	------	.8	3	5	------	3
Crimson clover	5.2	2.3	3.7	4.0	13	19	17	13
Fescue	3.8	3.0	1.0	2.2	9	15	15	11
Serecia lespedeza	.7	.2	2.9	2.3	36	25	25	30
Rye grass	------	1.7	2.7	1.4	------	30	20	21
Wild winter peas	------	2.0	9.9	4.8	------	20	56	55
Blackmedic clover	1.2	------	.5	.5	4	------	10	7
Button clover	------	.1	.1	.1	------	20	10	10
Yellow hop clover	.6	------	------	.1	12	------	------	12
Lapacea clover	------	------	.4	.2	------	------	7	7
Persian clover	------	------	------	.5	------	------	------	2

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

[2] Averaged 2.00 in the areas not shown.

[3] Averaged 2.05 in the areas not shown.

Appendix Table 20. Annual land preparation, fertilization, and seeding practices, temporary winter pasture, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

	Percentage of total acreage covered				Times over or rate where performed			
	Soil area				Soil area			
Item	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]
Land preparation:								
Discing	52.4	76.4	36.2	52.7	1.70	1.75	3.13	2.16
Breaking	6.3	24.8	4.2	8.5	1.00	1.00	1.00	1.00
Harrowing	34.5	56.7	39.1	39.5	1.02	1.62	1.88	1.62
Cultipacking	1.4	34.5	7.0	16.0	1.00	1.38	1.00	1.47
Middle breaking	28.5	......	......	9.0	1.00	......	......	1.00
Fertilizing	35.0	81.7	36.0	44.9	1.15	1.28	1.39	1.30
Limeing	3.8	......	1.5	1.9	1.00	......	1.00	1.00
Seeding	100.0	95.2	75.8	88.6	1.00	1.04	1.00	1.04
Fertilization:								
Lime	3.8	......	1.5	1.9	2,000	......	1,000	1,645
Basic slag	5.6	18.8	......	5.3	743	757	......	753
Mixed fertilizer	3.8	12.9	......	4.5	253	400	......	341
Nitrogen (N)	17.6	48.7	30.5	29.8	36	38	34	36
Phosphate (P_2O_5)	20.6	30.7	19.8	20.9	89	59	72	74
Potash (K_2O)	10.4	17.6	......	6.6	37	50	......	44
Seeding:								
Crimson clover	6.0	6.4	1.5	3.8	29	10	9	20
Dixie Wonder Peas	28.5	......	......	9.0	33	......	......	33
Wild winter peas	29.5	16.3	44.9	34.6	35	20	42	37
Austrian winter peas	3.3	4.8	......	2.0	29	30	......	29
Oats	34.9	83.1	32.7	42.8	87	103	113	101
Rye grass	.8	1.0	......	.4	20	25	......	22
Vetch	21.7	27.5	13.9	19.6	19	22	10	15

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Appendix Table 21. Annual land preparation, fertilization, and seeding practices, temporary summer pasture, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

	Percentage of total acreage covered				Times over or rate where performed			
	Soil area				Soil area			
Item	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]
Land preparation:								
Discing	59.3	......	100.0	70.4	2.00	......	2.00	2.26
Harrowing	59.3	......	100.0	70.4	1.00	......	2.00	1.12
Cultipacking	......	......	100.0	27.2	......	......	1.00	1.00
Fertilizing	67.8	......	100.0	76.5	1.00	......	1.00	1.24
Seeding	59.3	......	100.0	70.4	1.00	......	1.00	1.00
Fertilization:								
Basic slag	......	......	......	18.5	......	......	......	300
Nitrogen (N)	......	......	46.7	27.2	......	......	32	27
Phosphate (P_2O_5)	67.8	......	......	49.4	80	......	......	80
Seeding:								
Sudan	59.3	......	100.0	70.4	29	......	57	34

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Appendix Table 22. Land preparation, fertilization, and seeding practices, open permanent pasture, improved by land preparation, fertilization, and seeding, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

	Percentage of total acreage covered				Times over or rate where performed			
	Soil area				Soil area			
Item	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]
Land preparation:								
Discing	100.0	97.1	100.0	99.1	2.29	2.14	2.76	2.39
Breaking	5.1	40.5	74.5	38.7	1.00	1.02	1.35	1.23
Harrowing	77.5	78.9	96.5	84.1	1.44	1.20	3.25	2.11
Cultipacking	2.4	72.7	64.1	45.8	1.00	1.13	1.05	1.13
Fertilizing	99.2	100.0	100.0	99.8	1.66	1.18	1.38	1.38
Limeing	38.4	45.4	39.8	40.1	1.00	1.37	1.00	1.13
Seeding	100.0	100.0	100.0	100.0	1.15	1.13	1.38	1.21
Mowing	80.0	67.3	70.5	72.6	1.54	2.03	2.69	2.09
Fertilization:								
Lime	38.4	45.4	39.8	40.1	3,082	3,725	1,199	2,938
Basic slag	79.4	90.3	13.9	57.0	857	1,369	800	1,096
Mixed fertilizer	51.8	......	3.5	16.6	146	......	1,000	206
Nitrogen (N)	2.0	3.9	34.7	13.4	64	44	16	21
Phosphate (P_2O_5)	71.2	46.4	86.1	69.0	70	124	60	78
Potash (K_2O)	13.1	61.0	18.2	28.3	74	56	86	65
Seeding:								
Lespedeza	47.5	23.0	48.9	40.1	18	13	23	19
Dallis grass	49.6	23.4	13.9	26.4	10	12	20	12
White Dutch clover	50.8	66.7	4.3	41.5	7	5	4	5
Ladino clover	8.6	1.0	......	2.9	2	5	......	2
Crimson clover	27.6	4.1	38.1	27.2	10	24	20	14
Wild winter peas	......	6.8	38.1	14.9	......	20	30	29
Rye grass	......	......	34.7	11.7	......	......	20	20
Fescue	3.7	7.0	......	3.2	8	16	......	13
Serecia lespedeza	2.0	.8	8.7	5.5	40	25	20	27
Black medic clover	9.6	......	......	2.9	4	......	......	4
Yellow hop clover	4.5	......	......	1.3	12	......	......	12
Persian clover	......	......	......	4.9	......	......	......	2
Button clover	......	.2	......	.1	......	20	......	20

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Appendix Table 23. Annual land preparation, fertilization, and seeding practices, specified grazing crops, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

	Percentage of acreage covered			Times over or rate where performed		
Item	Oats	Oats and some legume	Wild winter peas	Oats	Oats and some legume	Wild winter peas
Land preparation:						
Discing	97.9	100.0	35.6	2.45	1.77	1.70
Breaking	18.9	18.5	-----	1.00	1.00	-----
Harrowing	71.3	82.5	29.5	1.64	1.45	1.77
Cultipacking	25.9	31.3	10.5	1.44	1.00	1.78
Fertilizing	95.1	89.2	8.4	1.44	1.15	1.00
Limeing	-------	15.3	-----	-----	1.00	-----
Seeding	100.0	100.0	66.7	1.00	1.05	1.00
Fertilization:						
Lime	-------	15.3	-----	-----	1,645	-----
Basic slag	2.9	27.3	-----	154	804	-----
Mixed fertilizer	19.4	3.7	-----	365	75	-----
Nitrogen (N)	81.7	46.3	-----	34	45	-----
Phosphate (P_2O_5)	39.4	41.6	8.4	82	69	62
Potash (K_2O)	12.7	-------	-----	57	------	------
Seeding:						
Oats	100.0	100.0	-----	92	88	-----
Vetch	-------	49.0	-----	-----	19	-----
Wild winter peas	-------	36.0	66.7	-----	19	43
Crimson clover	-------	25.1	-----	-----	14	-----

Appendix Table 24. Percentage of improved permanent pasture improved by specified methods and percentage of temporary grazing crops that were specified crops, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

	Soil area			
Item	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]
Improved permanent pasture:				
Fertilization, seeding and land preparation	22.5	41.5	13.4	17.3
Either fertilization, seeding or land preparation or a combination of two of these items				
Mowing	19.5	37.7	35.1	36.9
Total	100.0	100.0	100.0	100.0
Temporary winter pasture:				
Oats	19.8	48.4	29.4	30.0
Oats and some legume	17.0	34.7	2.6	13.0
Wild winter peas	20.1	2.9	54.1	33.1
Wild winter peas and vetch	6.2	1.9	13.9	8.3
Other	36.9	12.1	-------	15.6
Total	100.0	100.0	100.0	100.0
Temporary summer pasture:				
Sudan	59.3	-------	100.0	70.4
Kudzu	40.7	-------	-------	29.6
Total	100.0	-------	100.0	100.0

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Appendix Table 25. Cost of establishment and annual cost per acre for all improved permanent pasture, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil areas				Soil areas			
	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]
	Cost of establishment (dol.)[2]				Annual cost (dol.)[2]			
Land preparation	1.86	2.61	2.07	1.85	.41	.44	.40	.37
Fertilizer	6.97	9.51	4.33	5.58	2.48	3.41	1.52	1.99
Seed	2.59	3.57	2.92	2.56	.26	.36	.29	.26
Bushing	.34	.04	.08	.13	.50	.14	.13	.20
Fencing	-------	-------	------	------	.51	.56	.39	.45
Mowing	-------	-------	------	------	1.58	1.86	1.96	2.04
Total[3]	11.76	15.73	9.40	10.12	5.74	6.77	4.69	5.31

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

[2] Based on the following acreages: Sand Clay Hills, 3,989; Mixed Brown Loam, 1,711; Northeast Prairie, 7,465; and other areas, 3,096.

[3] When interest is charged at 5 percent on the investment in land, the annual cost is as follows: $7.88, $9.51, $6.98, and $7.67 for the Sand Clay Hills, Mixed Brown Loam, Northeast Prairie and average for all areas, respectively.

Appendix Table 26. Annual cost per acre unimproved permanent pasture, woodland pasture, temporary winter pasture and temporary summer pasture, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil area			
	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]
Unimproved permanent:[2]				
	Dollars			
Bushing	.47	.09	.08	.17
Fencing	.53	.49	.29	.40
Mowing	.10	-------	-------	.03
Total[3]	1.10	.58	.37	.60
Woodland:[2]				
Fencing[3]	.44	.34	.28	.37
Temporary winter:[2]				
Land preparation	2.46	4.52	2.79	3.14
Fertilizer	2.82	5.80	2.32	3.16
Seed	5.39	5.85	4.53	4.99
Fencing	.35	.33	.31	.32
Total	11.02	16.50	9.95	11.61
Temporary summer:[2]				
Land preparation	2.63	-------	5.29	3.63
Fertilizer	3.47	-------	6.57	5.23
Seed	1.78	-------	6.00	2.49
Bushing	.20	-------	-------	.15
Fencing	.65	-------	.58	.60
Total[3]	8.73	-------	18.44	12.10

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

[2] Based on the following acreages for the Sand Clay Hills, Mixed Brown Loam, Northeast Prairie, and other areas, respectively: unimproved permanent; 3,453, 2,304, 6,556, and 1,705; woodland: 7,299, 5,174, 3,272 and 1,542; temporary winter: 1,053, 626, 1,440, and 200; and temporary summer: 59, 0, 7, and 15.

[3] When interest is charged at 5 percent on the investment in pasture land, costs are as follows for the Sand Clay Hills, Mixed Brown Loam, Northeast Prairie, and average for all areas, respectively: unimproved permanent: $2.46, $1.86, $1.89, and $2.11; woodland $0.88, $0.76, $0.85, and $0.86; temporary winter: $12.68, $18.68, $11.90, and $13.52; temporary summer: $10.56, none seeded, $20.58, and $14.09.

Appendix Table 27. **Cost of establishment and annual cost per acre for improved permanent pasture improved by land preparation, fertilization, and seeding, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.**

Item	Soil area			Average all areas[1]	Soil area			Average all areas[1]
	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie		Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	
	Cost of establishment (dol.) [2]				Annual cost (dol.) [2]			
Land preparation	5.50	6.03	9.49	6.96	.95	.89	1.48	1.10
Fertilizer	13.22	17.44	7.82	12.18	4.58	6.26	3.00	4.41
Seed	12.31	6.90	12.63	10.39	1.23	.69	1.26	1.04
Bushing	.54	.04	.14	.22	--	--	--	--
Fencing	--------	--------	--------	--------	.77	.49	.41	.55
Mowing	--------	--------	--------	--------	1.52	1.95	2.34	1.95
Total[3]	31.57	30.41	30.08	29.75	9.05	10.28	8.49	9.05

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

[2] Based on the following acreages: Sand Clay Hills, 510; Mixed Brown Loam, 513; Northeast Prairie, 577; and other areas, 115.

[3] When interest is charged at 5 percent on the investment in land, the annual cost is as follows: $11.62, $13.58, $12.04, and $12.28 for the Sand Clay Hills, Mixed Brown Loam, Northeast Prairie, and average all areas, respectively.

Appendix Table 28. **Annual cost per acre, specified grazing crops, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.**

Item	Oats	Oats and some legume	Wild winter peas
		Dollars[1]	
Land preparation	5.77	4.85	1.70
Fertilizer	7.07	6.33	.33
Seed	5.37	10.02	3.42
Fences	.39	.42	.30
Total[2]	18.60	21.62	5.75

[1] Based on the following acreages: Oats 903, oats and some legume 406, and wild winter peas 1,099.

[2] When interest is charged at 5 percent on the investment in pasture land, the annual costs per acre are as follows: Oats $20.65, oats and some legume $23.82, and wild winter peas $7.95.

Appendix Table 29. **Replacement cost and annual cost of one mile of fence[1], 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.**

Item	Quantity	Cost per unit	Total cost
		Dollars	Dollars
Replacement cost per mile:			
Wire, 4-point barb	16 rolls	7.50	120.00
Staples	25 lbs.	.10	2.50
Posts, untreated	528	.25	132.00
Labor	167 hours	.40	66.80
Hauling (tractor & trailer)	2.5 hours	1.00	2.50
Total			323.80
Annual cost:			
Depreciation	-------	-----	16.19
Repairs	-------	-----	13.94
Total			30.13

[1] Erected in the usual manner.

Appendix Table 30. Acres of pasture per farm and per cow and annual pasture cost per farm and per cow, 139 beef cattle farms, Northeast and East Central Mississipi, July 1949-June 1950.

	Soil area				Soil area			
Item	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	Average all areas*	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	Average all areas*
	Per farm						Per cow	
Acres:								
Improved permanent	67	37	217	97	2.0	1.6	2.9	2.3
Unimproved permanent	58	51	175	86	1.7	2.1	2.3	2.1
Temporary winter	18	12	40	20	.5	.5	.5	.5
Temporary summer	1	--	**	**	***	--	***	***
Woodland	122	107	98	110	3.6	4.5	1.3	2.6
Annual cost (dollars):								
Improved permanent	387	251	1,015	517	11.58	10.54	13.50	12.42
Unimproved permanent	64	30	65	52	1.92	1.25	.86	1.25
Temporary winter	193	206	400	234	5.80	8.64	5.31	5.62
Temporary summer	9	--	1	5	.27	--	.01	.13
Woodland	53	37	27	41	1.60	1.56	.36	.98
Total****	706	524	1,508	849	21.17	21.99	20.04	20.40

*Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

**Less than .5 acre

***Less than .05 acre.

****When interest is charged at 5 percent on the investment in pasture land, total pasture cost for the Sand Clay Hills, Mixed Brown Loam, Northeast Prairie, and average for all areas, respectively, was as follows: per farm: $1,014, $761, $2,402, and $1,299; per cow: $30.32, $31.99, $31.79, and $31.20.

Appendix Table 31. Pasture credits, improved permanent pastures, 139 beef cattle farms, Northeast and East Central Misisssippi, July 1949-June 1950.

	Soil area			
Item	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	Average all areas[1]
Quantity per farm (pounds):				
Hay	3,818	2,748	11,379	4,695
Wild winter peas	--------	--------	414	86
Fescue	--------	63	--------	19
White Dutch clover	13	73	28	35
Serecia lespedeza	--------	--------	662	138
Value (dollars):				
Per farm	39.98	109.85	308.18	111.70
Per acre	.47	2.63	1.20	.95
Per cow	.94	4.09	3.45	2.22

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Appendix Table 32. Pasture credits, temporary winter pasture, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil area: Sand Clay Hills	Soil area: Mixed Brown Loam	Soil area: Northeast Prairie	Average all areas[1]
Quantity per farm (pounds):				
Hay	468	------	1,724	545
Oats	1,318	6,810	10,550	4,961
Wild winter peas	7	------	1,331	281
Crimson clover	109	122	------	79
Vetch	------	------	------	2
Value (dollars):				
Per farm	101.03	175.34	243.45	145.44
Per acre	5.28	11.48	4.90	6.09
Per cow	2.78	6.02	2.62	2.95

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Appendix Table 33. Pasture credits, temporary summer pasture, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil area: Sand Clay Hills	Soil area: Mixed Brown Loam	Soil area: North east Prairie	Average all areas[1]
Hay, quantity per farm (pounds)	2,000	------	------	791
Value per farm (dollars)	9.35	------	------	3.70
Value per acre (dollars)	8.71	------	------	6.35
Value per cow (dollars)	.27	------	------	.07

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

Appendix Table 34. Source of water, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil area: Sand Clay Hills	Soil area: Mixed Brown Loam	Soil area: Northeast Prairie	Average all areas[1]
		Percent		
Pond only	20	17	24	21
Creek only	47	32	3	31
Well only	------	--	10	2
Pond and creek	24	34	21	27
Pond and well	5	7	39	14
Creek and well	2	10	3	4
Pond, creek, and well	2	------	------	1
Total	100	100	100	100

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil area.

Appendix Table 35. **Quantities of feed used per farm and per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.**

	Soil area				Soil area			
Item	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]
	Per farm				Per cow			
Concentrates (cwt.):								
Cottonseed meal, cake or pellets	61	29	86	59	1.82	1.20	1.14	1.42
Corn	90	83	65	84	2.71	3.46	.87	2.01
Other	4	7	18	7	.12	.29	.24	.17
Total	155	119	169	150	4.65	4.95	2.25	3.60
Roughage (tons):								
Legume hay	7.5	10.5	14.8	10.5	.22	.44	.20	.25
Legume hay and grass hay	3.1	1.0	6.2	2.8	.09	.04	.08	.07
Grass hay	4.3	.5	57.0	14.4	.13	.02	.76	.35
Corn cob and shuck meal	1.4	1.2	.9	1.2	.04	.04	.01	.03
Cottonseed hulls	3.9	4.1	1.1	3.0	.12	.17	.01	.07
Other[2]	.5	1.5	1.4	1.3	.01	.07	.02	.03
Total	20.7	18.8	81.4	33.2	.61	.79	1.08	.80

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

[2] Silage converted to hay equivalent.

Appendix Table 36. **Marketing cost per farm and per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.**

	Soil area				Soil area			
Item	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]	Sand Clay Hills	Mixed Brown Loam	Northeast Prairie	Average all areas[1]
	Dollars per farm				Dollars per cow			
Commission fees	93	32	142	85	2.79	1.34	1.89	2.04
Hauling	16	12	37	19	.48	.50	.49	.46
Yardage	3	[2]	3	2	.09	.01	.04	.05
Other	1	----	----	1	.03	------	------	.02
Total	113	44	182	107	3.39	1.85	2.42	2.57

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil area.

[2] Less than $.50.

Appendix Table 37. Misclelaneous cost per farm and per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Soil area				Soil area			
	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	Average all areas[1]	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	Average all areas[1]
	Dollars per farm				Dollars per cow			
Veterinary fees and medicine	27	21	57	35	.82	.87	.76	.84
Spray materials and disinfectants	7	9	22	12	.22	.39	.30	.28
Taxes	55	40	118	68	1.64	1.67	1.57	1.64
Feed grinding	14	17	31	19	.41	.73	.41	.46
Salt	13	10	34	17	.38	.44	.45	.41
Minerals	3	7	13	7	.10	.29	.17	.17
Hauling purchased feeds	12	3	2	6	.35	.13	.03	.15
Automobile	26	25	46	29	.78	1.04	.61	.70
Other[2]	6	6	14	9	.18	.24	.18	.22
Total	163	138	337	202	4.88	5.80	4.48	4.87

[1] Includes 14 farms in the Brown Loam, Northeast Highlands, Pontotoc Ridge, and Flatwoods soil areas.

[2] Includes insurance on buildings, electricity, breeding fees, and telephone.

Appendix Table 38. Herd size related to costs and returns per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Herd size	Number farms	Total returns	Total cost	Returns to investment	Percent returns to investment
	No.	Dollars	Dollars	Dollars	Percent
10 - 15	31	93	75	18	4.4
16 - 25	38	79	81	— 2	— .5
26 - 50	39	80	68	12	2.8
51 and over	31	72	57	15	3.9

Appendix Table 39. Years in beef production related to costs and returns per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Years in beef production	Number farms	Total returns	Total cost	Returns to investment	Percent returns to investment
	No.	Dollars	Dollars	Dollars	Percent
Under 6	34	88	77	11	2.6
6 - 10	44	78	73	5	1.2
11 - 20	37	78	64	14	3.3
21 and over	24	82	66	16	3.8

Appendix Table 40. Date of calving related to cost and return per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	No. of farms	Total returns	Total cost	Returns to investment
	No.	Dollars	Dollars	Dollars
Percent of calves born in December and January:				
1 - 9	17	70	63	7
10 - 29	31	92	71	21
30 and above	20	78	80	— 2
Percent of calves born in Ferbraury and March:				
1 - 29	39	82	68	14
30 - 49	35	73	73	0
50 and above	45	80	70	10
Percent of calves born in February, March, April, and May:				
1 - 59	30	87	82	5
60 - 69	24	79	66	13
70 - 79	26	81	63	18
80 - 89	24	83	74	9
90 - 100	35	76	68	8

Appendix Table 41. Value of brood cows related to costs and returns per cow, 139 beef cattle farms Northeast and East Central Mississippi, July 1949-June 1950.

Item	Value of brood cows per head (dollars)			
	Under 115	115-125	126-154	155 and over
Farms (number)	33	34	52	20
Herd size (number of brood cows)	28	41	52	38
Value of cows per head (dollars)	98	120	146	212
Total investment (dollars)	344	382	447	530
Improved permanent pasture (acres)	1.5	2.7	2.3	2.4
Unimproved permanent pasture (acres)	2.6	1.3	2.0	2.6
Woodland pasture (acres)	3.8	2.8	2.6	1.4
Temporary winter pasture (acres)	.6	.3	.6	.4
Roughage fed (pounds)	1,558	1,515	1,483	1,810
Protein supplement fed (pounds)	157	109	109	192
Other concentrates fed (pounds)	242	321	325	480
Calf crop (percent)	88	81	83	80
Calves dying (percent)	6	6	3	4
Beef produced (pounds)	342	317	393	405
Value of beef produced (dollars)	62	62	83	97
Pasture credits (dollars)	8	4	8	3
Total returns (dollars)	70	66	91	100
Feed costs (dollars)	27	24	24	36
Pasture costs (dollars)	21	20	29	24
Labor costs (dollars)	10	7	8	10
Other costs (dollars)	13	10	12	13
Total costs (dollars)	71	61	73	83
Returns to investment (dollars)	—1	5	18	17
Returns to investment (percent)	—.3	1.3	4.0	3.2

Appendix Table 42. Feed cost related to costs and returns per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Feed cost per cow (dollars)			
	Under 15	15-21	22-34	35 and over
Farms (number)	37	35	32	35
Herd size (number of brood cows)	38	49	55	25
Value of cows per head (dollars)	127	139	132	152
Total investment (dollars)	411	400	417	446
Improved permanent pasture (acres)	1.9	2.0	2.5	2.5
Unimproved permanent pasture (acres)	2.6	1.8	2.5	1.4
Woodland pasture (acres)	2.9	3.1	1.7	2.5
Temporary winter pasture (acres)	.5	.5	.5	.4
Roughage fed (pounds)	443	1,223	1,953	2,729
Protein supplement fed (pounds)	45	100	127	262
Other concentrates fed (pounds)	162	206	291	654
Calf crop (percent)	79	85	84	85
Calves dying (percent)	2	5	6	6
Beef produced (pounds)	332	337	390	401
Value of beef produced (dollars)	66	70	83	83
Pasture credits (dollars)	4	5	5	10
Total returns (dollars)	70	75	88	93
Feed cost (dollars)	8	20	27	52
Pasture cost (dollars)	19	23	25	29
Labor cost (dollars)	7	7	9	11
Other cost (dollars)	11	10	13	12
Total cost (dollars)	45	60	74	104
Returns to investment (dollars)	25	15	14	—11
Returns to investment (percent)	6.1	3.8	3.4	—2.4

Appendix Table 43. Pasture cost per cow related to costs and returns per cow, 139 beef cattle farms Northeast and East Central Mississipppi, July 1949-June 1950.

Item	Pasture cost per cow (dollars)[1]			
	Under 8	8-15	16-25	26 and over
Farms (number)	33	35	33	38
Herd size (number brood cows)	45	47	38	37
Value of cows per head (dollars)	126	135	140	149
Total investment (dollars)	348	388	378	543
Improved permanent pasture (acres)	1.1	1.7	2.3	3.5
Unimproved permanent pasture (acres)	2.6	2.9	1.1	1.8
Woodland pasture (acres)	2.4	2.6	2.8	2.5
Temporary winter pasture (acres)	.2	.2	.4	1.1
Roughage fed (pounds)	1,530	1,623	1,497	1,592
Protein supplement fed (pounds)	92	155	123	155
Other cencentrates fed (pounds)	352	320	255	374
Calf crop (percent)	82	83	81	86
Calves dying (percent)	6	5	4	5
Beef produced (pounds)	357	355	334	405
Value of beef produced (dollars)	66	74	77	82
Pasture credits (dollars)	15	2	1	5
Total returns (dollars)	81	76	78	87
Feed cost (dollars)	24	29	23	29
Pasture cost (dollars)	13	15	19	46
Labor cost (dollars)	8	10	8	9
Other cost (dollars)	10	11	13	13
Total cost (dollars)	55	65	63	97
Returns to investment (dollars)	26	11	15	—10
Returns to investment (percent)	7.5	2.8	4.0	—1.8

[1] Pasture credits subtracted from pasture costs before grouping.

Appendix Table 44. Pasture management practices related to costs and returns per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	All farms having temporary winter pastures		All farms	
	Selling a part or all calves April-June	Not selling calves April-June	Saving hay or seed from pasture	Not saving hay or seed from pasture
Farms (number)	18	46	41	98
Herd size (number brood cows)	78	32	33	45
Value of cows (dollars)	136	136	138	138
Total investment (dollars)	420	454	476	394
Improved permanent pasture (acres)	2.0	2.6	3.0	1.9
Unimproved permanent pasture (acres)	1.3	2.1	2.1	2.1
Woodland pasture (acres)	2.5	2.3	1.8	2.9
Temporary winter pasture (acres)	1.2	1.0	.8	.3
Roughage fed (pounds)	1,439	1,783	1,922	1,412
Protein supplement fed (pounds)	166	100	100	146
Other concentrate fed (pounds)	300	280	322	329
Calf crop (percent)	81	85	89	81
Calves dying (percent)	2	5	5	5
Beef produced (pounds)	378	372	413	344
Value of beef produced (dollars)	80	78	85	71
Pasture credits (dollars)	16	8	21	----
Total returns (dollars)	96	86	106	71
Feed cost (dollars)	26	25	28	26
Pasture cost (dollars)	34	33	40	17
Labor cost (dollars)	7	7	9	9
Other cost (dollars)	11	14	12	11
Total cost (dollars)	78	79	89	63
Returns to investment (dollars)	18*	7*	17	8
Returns to investment (percent)	4.3	1.5	3.6	2.0

*Producers not having temporary winter pasture had returns to investment of $11 per cow.

Appendix Table 45. Health and sanitation practices related to costs and returns per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-Junne 1950.

Item	Number health and sanitation practices carried out[1]			
	None	1	2	3 or more
Farms (number)	21	27	55	36
Herd size (number brood cows)	23	70	36	40
Value of cows per head (dollars)	120	133	137	152
Total investment (dollars)	352	451	415	439
Improved permanent pasture (acres)	1.1	2.8	2.3	2.3
Unimproved permanent pasture (acres)	3.0	2.5	2.0	1.4
Woodland pasture (acres)	4.7	3.0	2.0	2.0
Temporary winter pasture (acres)	.4	.3	.5	.6
Roughage fed (pounds)	1,181	1,693	1,496	1,789
Protein supplement fed (pounds)	141	159	128	115
Other concentrates fed (pounds)	257	233	373	367
Calf crop (percent)	83	83	82	85
Calves dying (percent)	2	6	6	4
Beef produced (pounds)	340	336	376	380
Value beef produced (dollars)	64	64	78	85
Pasture credits (dollars)	1	4	5	12
Total returns (dollars)	65	68	83	97
Feed costs (dollars)	26	24	27	27
Pasture cost (dollars)	13	21	27	28
Labor cost (dollars)	10	8	10	8
Other cost (dollars)	11	9	10	15
Total cost (dollars)	60	62	74	78
Returns to investment (dollars)	5	6	9	19
Returns to investment (percent)	1.4	1.3	2.2	4.3

[1] Spraying for flies, treating for grubs, treating for internal parasites, vaccinating for blackleg, etc., were all given equal weight.

Appendix Table 46. Combined effect of quality of cows,[1] feed costs,[2] pasture cost,[3] and health and sanitation practices[4] on costs and returns per cow, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Good cows	Poor cows	Good cows and low feed costs	Poor cows and high feed costs	Good cows, low feed costs and low pasture costs	Poor cows, high feed costs and high pasture costs	Good cows, low feed costs, low pasture costs, and good health practices	Poor cows, high feed costs, high pasture costs, and poor health practices
				All farms having				
Farms (number)	72	67	35	30	16	13	8	3
Herd size (number brood cows)	48	35	53	34	59	43	54	75
Value of cows per head (dollars)	164	109	157	108	159	112	164	113
Total investment (dollars)	470	363	445	356	401	435	422	347
Improved perm. pasture (acres)	2.3	2.1	2.0	2.3	1.5	3.7	1.8	5.2
Unimproved perm. pasture (acres)	2.2	1.9	2.3	1.7	2.5	.9	1.8	....
Woodland pasture (acres)	2.3	3.3	2.2	2.7	2.3	1.8	1.8	4.2
Temporary winter pasture (acres)	.5	.4	.7	.5	.4	.8	.2	.7
Roughage fed (pounds)	1,574	1,536	880	2,483	1,106	2,577	825	1,967
Protein supplement fed (pounds)	157	133	70	206	35	195	56	350
Other concentrates fed (pounds)	368	282	174	393	119	369	138	....
Calf crop (percent)	82	84	81	86	88	89	83	84
Calves dying (percent)	3	6	2	7	2	7	3	4
Beef produced (pounds)	396	329	389	386	388	402	392	247
Value of beef produced (dollars)	87	62	83	73	79	81	88	44
Pasture credits (dollars)	7	6	5	8	8	6	12	2
Total returns (dollars)	94	68	88	81	87	87	100	46
Feed cost (dollars)	27	25	14	40	14	37	14	27
Pasture cost (dollars)	28	20	24	22	15	35	19	23
Labor cost (dollars)	8	8	6	9	6	7	7	8
Other cost (dollars)	13	13	11	13	5	14	5	13
Total cost (dollars)	76	66	55	84	40	93	45	71
Returns to investment (dollars)	18	2	33	—3	47	—6	55	—25
Returns to investment (percent)	3.8	.6	7.4	—.8	11.7	—1.4	13.0	—7.2

[1] Good cows: above average value of cows for all farms studied; poor cows: below the average value of cows for all farms studied.

[2] Low feed cost: below average for all farms studied; high feed cost: above average for all farms studied.

[3] Low pasture cost: below average for all farms studied; high pasture costs: above average for all farms studied; pasture credits were subtracted from total pasture cost before the average was calculated and grouping made.

[4] Good health practices: above average for all farms studied; poor health practices: below average for all farms studied.

Appendix Table 47. Prices used for pasture credits, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Unit	Price	Item	Unit	Price
		Dollars			Dollars
Oats	bu.	.72	Crimson clover	lb.	.72
Wild winter peas	lb.	.07	Vetch	lb.	.19
Fescue	lb.	.62	Legume hay	ton	17.00
White Dutch clover	lb.	.72	Legume and grass hay	ton	13.00
Serecia lespedeza	lb.	.28	Grass hay	ton	9.00

Appendix Table 48. Fertilizer prices per ton, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Type of fertilizer	Price	Type of fertilizer	Price
	Dollars		Dollars
Ammonium nitrate	70.00	Phosphate, 20%	25.60
Nitrate of soda	65.00	Phosphate, 46%	55.00
Basic slag	13.40	0-5-5	26.40
Calcium silicate slag	4.00	0-14-2	30.80
Lime	5.00	0-14-7	40.00
Potash, 25%	17.60	5-10-5	44.00
Potash, 50%	52.00	6-8-4	43.80
Potash, 60%	60.00	6-8-8	46.70

Appendix Table 49. Feed prices, 139 beef cattle farms, Northeast and East Central, Mississippi, July 1949-June 1950.

Type of feed	Unit	Price	Type of feed	Unit	Price
		Dollars			Dollars
Cottonseed cake	cwt.	3.10	Corn cobs and shucks	cwt.	.50
Cottonseed meal	cwt.	3.50	Silage	ton	5.33
Cottonseed pellets	cwt.	3.65	Legume hay[1]	ton	22.00
Corn	bu.	1.08	Legume and grass hay[1]	ton	18.00
Oats	bu.	.89	Grass hay[1]	ton	14.00
Cottonseed	ton	43.40	All hay[1]	ton	22.00
Cottonseed hulls	ton	16.60			

[1] Hay was charged at $2 higher when baled, $2 lower when loose, and $3 lower when stacked.

Appendix Table 50. Seed price per pound, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Type of seed	Price	Type of seed	Price
	Dollars		Dollars
Dallis grass	.55	Button clover	1.00
Lespedeza	.25	Yellow hop clover	.60
White Dutch clover	.75	Persian clover	.60
Ladino clover	1.85	Lapacea clover	.60
Crimson clover	.75	Dixie Wonder pea	.10
Fescue	.65	Austrian winter pea	.08
Serecia lespedeza	.30	Vetch	.20
Rye grass	.13	Sudan	.10
Wild winter peas	.12	Oats	.05
Black medic clover	.60		

Appendix Table 51. Cost per acre once over for pasture land preparation and mowing, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

Item	Cost[1]	Item	Cost[1]
	Dollars		Dollars
Discing	1.00	Applying fertilizers	.88
Breaking	2.17	Seeding	.88
Harrowing	.54	Mowing	1.23
Cultipacking	62		

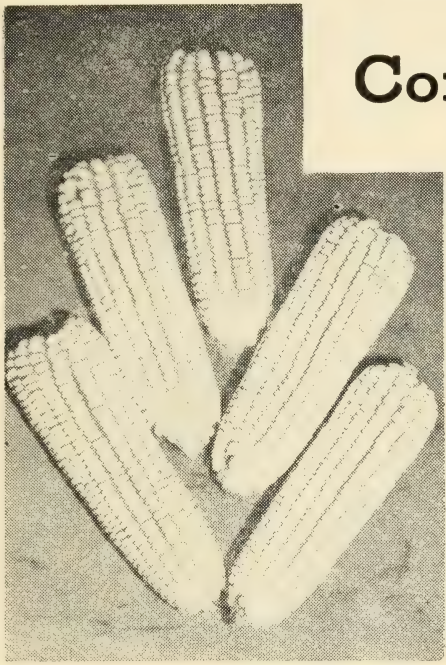
[1] Includes equipment, power and labor.

Appendix Table 52. Average prices received for beef animals, 139 beef cattle farms, Northeast and East Central Mississippi, July 1949-June 1950.

	Soil area			
Class of animal	Sand Clay Hills	Mixed Brown Loam	North-east Prairie	Average all areas[1]
	Dollars per cwt.			
Cows and heifers, 2+	16.69	16.51	15.80	16.99
Heifers, 1-2	17.86	18.18	18.18	20.96
Bulls, 1+	20.88	20.13	16.73	23.05
Steers, 1+	18.35	18.69	17.89	18.29
Calves, 1+	21.95	20.65	20.62	21.21
Average for all animals	19.99	19.73	19.53	20.08

[1] Includes 14 farms in the Brown Loam, Pontotoc Ridge, Flatwoods, and Northeast Highlands soil areas.

BULLETIN 498 JANUARY 1953



Corn Hybrids

And Varieties

1952 Tests In Mississippi

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

1953 Hybrid Recommendations

North Mississippi (North of U. S. Highway 82)

- Dixie 17 (white)
- Dixie 33 (white)
- Dixie 22 (yellow)
- Pfister (PAG) 631 (white)
- Funk G779W (white)
- Funk G785W (white)

Central Mississippi (North of U. S. Highway 80 and South of U. S. Highway 82)

- Dixie 11 (white)
- Dixie 18 (yellow)
- Funk G785W (white)
- Coker 811 (white)
- Dixie 17 (white) early feed or early hogging off
- Dixie 33 (white) early feed or early hogging off
- Dixie 22 (yellow) early feed or early hogging off
- Pfister (PAG) 631 (white) early feed or early hogging off
- Funk G779W (white) early feed or early hogging off

South Mississippi

- Dixie 18 (yellow)
- Coker 811 (white)
- La. 521 (white)
- Hybrids recommended for North Mississippi: use only for early feed or early hogging off

These corn tests are a cooperative project between the Mississippi Experiment Station and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, and the Division of Cereal and Forage Insect Investigations, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture.

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S. P. Crockett, superintendent, North Mississippi Branch Station, Holly Springs.

Robert Albritton, superintendent, Northeast Mississippi Branch Experiment Station, Verona.

Louis Walton, superintendent, Black Belt Branch Station, Brooksville.

R. E. Coats, agronomist, Brown Loam Branch Station, Raymond.

K. C. Freeman, agronomist, Coastal Plain Branch Station, Newton.

T. E. Ashley, superintendent, South Mississippi Branch Station, Poplarville.

B. C. Hurt, superintendent, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc.

Two plantation trials included in these tests were made possible through the cooperation of E. T. Shaffer, Yazoo City and Harris Barnes, Jr. of Connell and Company, Sherard.

Corn Hybrids And Varieties --- 1952 Tests

In spite of the worst drought in the history of Mississippi since weather records have been kept, the average yield of corn in Mississippi in 1952 was 16 bushels per acre. The average corn yield in the state for the 10-year period 1935-44 was 15.3 bushels per acre.

The ability of Mississippi farmers to grow as much corn per acre in the most unfavorable year on record as compared to the relatively normal years 1935-44 is due to three major factors. The first is the increase in the use of adapted hybrid seed corn. During the 10-year period 1935-44, almost no adapted hybrid corn was available to the farmers of the state. In 1952 however, 35 percent of the Mississippi corn acreage was planted with hybrid corn.

The second factor is the use of fertilizer, especially nitrogen. Liberal use of nitrogen on many fields held the corn in a green vegetative condition until rains arrived. In former years, without the use of high rates of nitrogen and hybrids, the corn dried up and died when a drought occurred. The third factor was the elimination of many marginal acres which were taken out of corn and planted to pastures or other crops.

In the future with more and more adapted hybrids being bred for the South, coupled with adequate stands and high rates of nitrogen fertilizers, Mississippi farmers should double or treble their 1952 yields in an average season.

The performance of a hybrid over a period of years is the best guide as to its desirability. Based on their performance in the past several years as well as in 1952, the following hybrids are recommended for Mississippi. The availability of planting seed has been considered in these recommendations; this automatically keeps any experimental hybrid from the list.

These tests, designed to measure the performance of corn hybrids and varieties, were planted at State College, eight of the branch stations, and two farms in the Delta. The seed was collected from planting seed being sold at seed stores. The seed of each Dixie hybrid was obtained from a composite of the seed obtained from all certified growers for laboratory analysis by Dr. A. D. Suttle, of State College, so that they are representative of the seed on the market.

As farmers become more experienced in the use of corn hybrids they learn that all hybrids do not perform equally well. At the present time a few farmers are dissatisfied with corn hybrids because when purchasing the seed they did not specify a particular hybrid. Although there are a number of adapted hybrids better than the best adapted varieties, the Experiment Station has always recommended the use of a good adapted open-pollinated variety in preference to a poor unadapted hybrid which not only gives low yield but often has poor quality grain, and practically no insect resistance.

Explanation of Tables

The state was divided into 3 sections, North Mississippi, Central Mississippi and South Mississippi. Holly Springs, Pontotoc, Verona, State College, Stoneville, and Clarksdale were placed in the northern group; Brooksville, Newton, Raymond and Yazoo City in the central group; and Poplarville in the southern group. Within a group all entries were uniform. The placing of corn hybrids in one of the divisions was done on the recommendation of the breeder. The entries were randomized with 5 replications in each test except Poplarville which had 6. Each plot was two rows wide and ten hills long with rows and hills 40" apart (42" at Brooksville and Poplarville, and 38" at Yazoo City and Clarksdale).

Five seeds were planted per hill and thinned to two or three plants. Tests at Holly Springs, Pontotoc, Newton, Raymond and Poplarville were thinned to two stalks per hill which with a perfect stand resulted in about 7800 plants per acre. Tests at State College, Stoneville, Clarksdale, Yazoo City and Verona were thinned to three plants per hill which resulted in a perfect stand of about 12000 plants per acre. The sugarcane beetle greatly reduced the stand at Raymond.

Lengthy drought periods seriously affected the yield of a majority of the tests. Late maturing hybrids were more adversely affected than the earlier hybrids. The lack of moisture preceding harvest is reflected in the generally low percentage of unsound ears.

The percentage of plants lodged is based on actual counts. All plants broken below the top ear-bearing node (joint) were classified as stalk lodged while all plants leaning 30 degrees or more were root lodged.

Ears infested with rice weevil and corn earworms are shown in percent or the damage is given in a rating. Rice weevil damage was so slight that a measure of resistance could be obtained only at Poplarville. Data on earworm infestation are reported from six locations. Ear height is reported as the distance in feet from the ground to the point where the top ear is attached to the plant. Ears per plant indicate whether the hybrid is one-eared or prolific; it is obtained by dividing the number of ears harvested by the total number of plants. Husk length is reported in the number of inches that the husk extends beyond the tip of the ear.

The shelling percentage is a measure of the ratio of grain to cob in a sample of ear corn. A shelling percentage of 85 means that in 100 pounds of ear corn, 85 pounds are grain and 15 pounds are cobs. Generally speaking prolific hybrids have more grain and less cob than do one-eared hybrids. The commonly used formula, 70 pounds of ear corn equal one bushel, is based upon dry corn having a shelling percentage of 80. When a farmer sells corn with a shelling percentage of 84 according to this formula, he is giving away 4 pounds of grain in every 100 pounds of ear corn.

North Mississippi

The tests at State College and Verona were the two highest yielding tests in 1952. The tests on sandy loam at Stoneville and Clarksdale were fair while the tests at Pontotoc and Holly Springs and the test on clay at Stoneville were badly hurt by the drought.

The average of the data from the Northern tests is shown in Table 1 and the individual tests in Table 2-9. A Mississippi experimental white hybrid Miss. 1123 and three experimental Tennessee hybrids T0107, T0114 and T0142 were consistently high yielding and had excellent lodging resistance. There is no seed available for 1953 of these experimental hybrids but the results emphasize that better hybrids are on the way.

Pfister (PAG) 631 was one of the commercial hybrids that was consistently high yielding. PAG 631 is an early maturing hybrid and this favored it during the droughty season. It did not stand as well as many of the other hybrids and had 28 percent unsound ears in the Stoneville sandy loam test. This is consistent with its performance in past years. Two new Pfister hybrids, PAG 486 (yellow) and PAG 655 (white), were tested for the first time in 1952; they stood well but their yields were mediocre and several more years testing are needed to properly evaluate them.

Funk G779W was outstanding in yielding well in all the North Mississippi tests except two. This is a new white hybrid with a short husk, a medium to large ear with a good standability record. Where rice weevils are not a problem, this hybrid appears to be very promising. Funk G785W performed well in 1951 and fairly well in 1952. Although it lodges, much of this is root lodging which is not as serious as stalk breaking. Funk G785W has good quality white grain and good husk coverage. Funk G711 has a very short husk and in addition stalk breaks badly. Funk G721 was rather low in yield and stalk broke badly in some tests.

Coker 911 is a new white prolific hybrid that stands well and has good grain quality. However, seed is not available for planting in Mississippi in 1953.

Of the older commercial hybrids that have been grown for several years Dixie 11, Dixie 17, Dixie 22 and Dixie 33 yielded well in 1952 as well as in the three-year period 1950-52 (Table 1) Dixie 17 and Dixie 33 are white prolific hybrids that yield excellently. Dixie 17 is better quality corn than Dixie 33 but Dixie 33 stands better than Dixie 17. Dixie 22 is a prolific yellow hybrid that has yielded well and stood well over a period of years. Dixie 82, a new yellow hybrid, has a better husk than Dixie 22 and is more weevil resistant than Dixie 22 but not as weevil resistant as Dixie 18. Little seed of Dixie 82 is available to Mississippi farmers for the 1953 season.

Many farmers believe that Jarvis is a good open pollinated corn for poor soils or poor weather conditions. This was emphatically disproved by the very low yields of Jarvis in 1952. The adapted hybrids yielded from 66-93 percent more corn than did Jarvis (see Table 1). These results again confirm the fact that good hybrid seed pays off handsomely in bad seasons as well as in good seasons.

Central Mississippi

All of the tests grown in Central Mississippi were hard hit by drought and in addition, the test at Raymond had a high percentage of the plants killed by the rough headed corn stalk beetle when the plants were in the first few weeks of growth. As a result of the poor season, the recommendations of hybrids are made largely on the basis of performance in previous years.

The ability of certain hybrids to stand, even under severe conditions, is well shown in Table 10. The two Coker hybrids 911 and 811, Dixie 18, Dixie 82, Pfister (PAG) 486 and Miss. 1123 all stood excellently and yielded satisfactorily.

The earlier maturing hybrids, Dixie 17, 22, 33, Pfister (PAG) 631 and Miss. 1123 led in yield in the 4-station Central Mississippi tests. These hybrids do not have the husk protection, with the possible exception of Miss. 1123, that is necessary to protect the ears from rice weevil. For corn that is to be cribbed, Dixie 11, Dixie 18, Coker 811 and Funk G785W are recommended.

Dixie 11 is a prolific white hybrid with a fairly long tight husk. The quality of the grain is excellent and the shelling percentage is high. However, the hybrid root lodges badly under some conditions.

Dixie 18 is a yellow hybrid with an excellent husk for Central Mississippi. The grain is of excellent quality and the hybrid has excellent roots and stalks so that it stands well at harvest.

Coker 811 is a prolific white hybrid which stands excellently and has excellent quality hard white grain. Plant and ear height are relatively low and over the three-year period 1950-52 it has yielded as much grain as Dixie 18.

Funk G785W performed well in 1951 and has a fair record in 1952. This hybrid performed fairly well at the stations bordering highway 82 (Tables 4 and 5). Funk G721 lodged badly.

South Mississippi (Poplarville)

Dixie 18, Coker 811, and Dixie 11 were the highest in yield for the three-year period of 1950-52 (Table 15). Dixie 18, a yellow hybrid, and Coker 811, a white hybrid, both stand well and have hard excellent quality grain; both are relatively resistant to the rice weevil. Dixie 11 yielded well but is susceptible to lodging and rice weevil, although it has much more weevil resistance than many hybrids. The two Funk hybrids, G791W and G737 cannot be recommended because of their low yields. The earlier maturing hybrids were favored in the drought year of 1952 and blanketed the top of the test in yield. Coker 911, Dixie 22, Dixie 33 and Miss. 1123 are all adapted farther north and should not be used in south Mississippi except for early feed or early hogging off. Louisiana 521, a full season hybrid, is relatively resistant to rice weevil but lodges badly; the grain is of good quality.

A local variety, Shoe Peg, was lowest in yield at Poplarville. It does have a high shelling percent and excellent weevil resistance, but adapted hybrids such as Dixie 18 yielded 66 percent more grain while Dixie 11 yielded 124 percent more grain. The farmer cannot afford to grow low yielding open pollinated varieties such as Shoe Peg when he can get so much more corn from some of the better hybrids, even though the local variety has some good characteristics.

Table 1. Average of data from hybrid corn tests grown at Verona, State College, Stoneville, Clarksdale, Pontotoc (Pontotoc Ridge), and Pontotoc (Flatwoods) 1952.

Pedigree	Acre yield	Av.[1] yield 1950-52	Plants erect at harvest	Lodging		Ear ht.	Ears per plant	Husk[2] length	Stand
				Root	Stalk				
	bu.	bu.	%	%	%	ft.	no.	in.	%
Miss. 1123	57.8		92	3	5	4.3	1.1	3.3	96
TO114	54.8		95	3	2	3.9	1.0	1.9	92
TO142	54.3		91	7	2	4.2	1.0	1.8	92
Funk G779W	53.4		84	10	6	3.9	0.9	1.3	93
Pfister (PAG) 631	52.1	73.1	73	15	12	3.2	0.9	2.5	94
Dixie 22	51.8	79.0	80	11	9	4.3	1.0	2.5	94
TO107	51.3		94	5	1	4.2	0.8	2.2	96
Dixie 82	51.1		87	9	4	4.5	1.1	3.3	96
Dixie 33	51.0	8.38	80	15	5	4.2	1.0	1.8	95
Dixie 11	51.0	82.6	63	32	5	4.2	1.1	3.1	96
Dixie 17	49.2	83.0	72	12	16	4.0	1.0	2.2	92
Funk G711	49.0		75	6	19	3.9	0.8	1.4	94
Funk G785W	47.9		78	13	9	4.5	1.0	2.2	94
Coker 911	47.4		90	6	4	3.7	1.0	2.3	96
Pfister (PAG) 486	47.0		87	4	9	3.8	1.0	2.1	96
T0009	46.6		92	4	4	4.2	0.8	2.6	95
Funk G721	45.8		71	14	15	3.8	0.9	2.1	93
Pfister (PAG) 655	44.2		89	8	3	4.2	0.9	2.6	97
Jellicorse*	42.7	68.9	71	17	12	3.7	1.0	1.8	92
Dixie 18	40.9	76.7	80	11	9	4.9	0.9	3.6	97
Coker 811	39.0	69.9	93	4	3	3.7	0.9	2.7	94
Station Mosby*	37.4	69.2	63	25	12	4.8	0.8	2.3	93
Jarvis (Sewell)*	29.9		66	18	16	3.3	0.7	2.2	90

*Open pollinated variety [1] Four station average [2] Five station average

Table 2. Hybrid corn test at Holly Springs, 1952.

Pedigree	Acre yield	Average yield 1949-51	Plants erect at harvest	Lodging Root	Lodging Stalk	Ear ht.	Ears per plant	Stand
	bu.	bu.	%	%	%	ft.	no.	%
Pfister (PAG) 631	18.2	54.0	64	30	6	2.6	0.7	88
Funk G721	9.6		60	35	5	3.2	0.5	85
Dixie 17	9.4	57.0	65	12	23	3.2	0.5	92
Coker 911	9.0		87	10	3	2.9	0.5	93
Jellicorse*	8.3	47.2	63	27	10	2.8	0.4	88
Dixie 22	7.8	55.7	76	11	13	3.4	0.4	91
Miss. 1123	7.3		92	1	7	3.4	0.4	96
Dixie 33	7.3	61.0	72	20	8	3.4	0.4	94
Dixie 11	6.0	47.6	49	42	9	3.9	0.5	86
Jarvis (Sewell)*	5.9		61	28	11	2.6	0.3	90
Pfister (PAG) 486	5.6		90	7	3	2.9	0.3	94
TO114	4.1		91	4	5	3.1	0.3	83
T0009	4.1		76	6	18	3.5	0.2	86
T0107	3.9		88	6	6	3.4	0.3	88
Coker 811	3.4		88	10	2	3.0	0.2	94
Station Mosby*	3.2	41.9	69	20	11	4.4	0.2	84
T0142	2.9		79	18	3	3.4	0.3	74
Pfister (PAG) 655	2.6		72	24	4	3.1	0.2	92
Funk G779W	2.5		62	30	8	2.9	0.2	91
Funk G785W	2.4		61	24	15	3.5	0.2	92
Dixie 18	2.2		75	14	11	3.4	0.4	88
Funk G711	2.0		64	22	14	3.1	0.1	96
Dixie 82	1.4		83	8	9	3.6	0.2	94

A difference in yield of 5.2 bushels per acre is required to be considered significant.
*Open pollinated variety

Table 3. Hybrid corn test at Verona, 1952.

Pedigree	Acre yield	Av. yield 1950-52	Plants erect at harvest	Lodging Root	Lodging Stalk	Ears infested earworm	Ear ht.	Ears per plant	Stand
	bu.	bu.	%	%	%	%	ft.	no.	%
Miss. 1123	97.3		90	6	4	84	4.8	1.5	94
T0107	91.9		92	7	1	95	4.6	1.1	94
T0142	90.9		87	11	2	94	4.6	1.3	86
Funk G779W	90.5		87	11	2	97	4.3	1.2	92
T0114	90.4		96	3	1	93	4.3	1.3	90
Dixie 82	87.8		64	31	5	87	5.0	1.3	95
Dixie 22	84.8	75.6	69	23	8	92	4.7	1.2	91
Dixie 33	84.4	81.1	74	22	4	96	4.4	1.2	94
Funk G785W	83.3		64	31	5	82	5.0	1.4	94
Dixie 11	82.7	79.5	44	53	3	86	4.4	1.6	93
T0009	81.4		92	7	1	95	4.5	1.0	94
Pfister (PAG) 631	81.3	71.4	74	15	11	98	3.4	1.0	88
Funk G711	79.5		80	7	13	97	4.4	1.0	93
Coker 911	78.3		91	8	1	88	4.0	1.1	96
Pfister (PAG) 486	77.9		83	9	8	93	4.1	1.2	93
Jellicorse*	74.5	65.5	72	17	11	92	3.7	1.3	90
Dixie 18	74.4	73.6	74	22	4	78	5.3	1.2	94
Pfister (PAG) 655	74.1		83	14	3	89	4.8	1.2	96
Dixie 17	71.9	74.7	55	34	11	94	4.2	1.3	85
Funk G721	70.3		65	24	11	89	4.3	1.0	90
Station Mosby*	67.6	66.2	55	35	10	89	5.3	1.1	92
Coker 811	66.2	67.6	94	6	0	78	3.8	1.2	90
Jarvis (Sewell)*	57.2		69	17	14	87	3.7	1.1	91

A difference in yield of 9.8 bushels per acre is required to be considered significant.
*Open pollinated variety.

Table 4. Hybrid corn test at State College, 1952.

Pedigree	Acre yield	Average yield 190-52	Plants erect at harvest	Lodging		Ears infested earworm	Dead plants Aug. 18	Ear ht.	Ears per plant	Husk length	Shelling	Days to 50% silk	Stand
				Root	Stalk								
	bu.	bu.	%	%	%	%	%	ft.	no.	in.	%	no.	%
Funk G779W	87.4		95	2	3	91	5.8	3.8	1.1	1.0	86	75	98
T0142	86.8		98	1	1	88	1.0	4.0	1.2	1.4	84	76	98
Miss. 1123	83.3		98	0	2	78	20.2	3.8	1.3	4.0	84	75	99
Dixie 11	82.4	97.8	74	21	5	69	14.4	3.8	1.5	4.2	88	78	99
T0114	80.9		98	1	1	90	17.1	3.6	1.1	1.2	85	74	98
Dixie 33	80.6	98.3	91	6	3	94	33.1	4.0	1.2	1.4	85	73	98
Funk G711	80.0		87	1	12	92	23.6	3.7	1.0	0.8	85	74	97
T0107	79.6		99	1	0	89	10.4	4.2	1.0	2.0	84	75	99
Pfister (PAG) 655	78.6		97	1	2	77	9.5	4.2	1.2	2.4	85	76	98
T0009	78.4		97	1	2	94	20.9	4.3	1.0	2.8	84	74	99
Dixie 17	78.4	96.7	73	1	26	86	49.5	3.8	1.3	2.8	87	74	97
Funk G785W	77.6		94	2	4	70	9.4	4.5	1.3	3.0	85	77	99
Dixie 22	76.4	92.3	86	8	6	87	31.5	4.1	1.1	2.4	83	75	98
Pfister (PAG) 486	75.6		93	1	6	80	37.9	3.7	1.2	2.2	88	73	99
Pfister (PAG) 631	74.9	90.5	91	4	5	88	51.4	3.0	1.0	2.0	82	69	99
Funk G721	74.5		81	12	7	78	26.5	3.5	1.1	2.8	86	75	98
Coker 911	73.6		95	1	4	82	19.2	3.4	1.1	1.8	86	75	99
Dixie 82	72.4		94	0	6	79	28.8	4.2	1.4	4.2	81	76	97
Dixie 18	70.8	94.8	88	4	8	59	19.5	4.6	1.2	4.4	86	80	99
Station Mosby*	69.4	82.6	69	18	13	79	15.9	4.5	1.1	2.4	85	79	99
Coker 811	65.9	75.4	97	1	2	62	13.8	3.5	1.3	3.8	84	79	99
Jellicorse*	63.3	81.0	85	8	7	79	45.3	3.4	1.1	2.4	83	74	99
Jarvis (Sewell)*	44.6		69	18	13	71	35.7	2.8	0.8	2.0	88	78	97

A difference in yield of 6.5 bushels per acre is required to be considered significant.

*Open pollinated variety

Table 5. **Hybrid corn test at Stoneville, 1952.**

Pedigree	Acre yield	Average yield 1950-52	Plants erect at harvest	Lodging		Earworm damage rating[2]	Ear ht.	Ears per plant	Husk[1] length	Unsound ears	Stand
				Root	Stalk						
	bu.	bu.	%	%	%		ft.	no.	in.	%	%
T0142	54.4		97	0	3	3.4	4.4	1.0	1.8	8	89
T0114	53.9		98	0	2	3.6	4.0	1.0	1.2	13	88
Funk G779W	48.7		95	1	4	4.0	3.9	0.9	0.5	18	93
Dixie 17	47.5	93.0	84	0	16	2.8	4.2	1.0	1.8	6	90
Dixie 22	47.1	87.1	96	0	4	2.8	4.4	0.9	2.5	11	94
Dixie 11	46.8	88.3	89	5	6	1.8	4.4	1.0	2.8	6	96
Dixie 33	46.7	89.5	93	0	7	3.8	4.5	0.9	1.5	11	88
Miss. 1123	45.7		89	1	10	2.0	4.4	1.0	3.8	11	91
Dixie 82	44.5		91	5	4	1.8	4.8	1.0	3.0	10	87
Pfister (PAG) 631	42.7	70.8	92	0	8	3.2	3.5	0.8	2.0	28	91
Funk G721	42.1		75	0	25	2.0	4.0	0.8	2.0	5	90
Pfister (PAG) 486	41.5		96	0	4	2.4	3.8	0.9	2.0	8	90
Funk G711	40.6		69	0	31	4.0	4.0	0.8	0	14	92
Funk G785W	40.0		86	5	9	2.0	4.6	0.9	2.2	10	90
T0107	37.4		95	0	5	3.6	4.2	0.7	1.5	12	93
T0009	37.2		97	0	3	4.0	4.4	0.7	1.8	26	93
Coker 911	34.9		94	0	6	2.2	3.8	0.8	2.5	9	91
Jellicorse*	34.9	75.5	90	0	10	3.2	3.7	0.8	1.5	18	90
Pfister (PAG) 655	34.5		94	0	6	2.4	4.4	0.8	2.8	12	87
Coker 811	29.9	82.1	94	0	6	1.4	4.0	0.8	2.8	5	93
Dixie 18	29.5	80.9	79	1	20	1.8	5.3	0.7	3.2	6	94
Station Mosby*	29.1	75.0	74	7	19	2.6	4.9	0.7	2.2	13	84
Jarvis (Sewell)*	20.6		70	5	25	2.2	3.7	0.6	2.5	14	88

A difference in yield of 10.7 bushels per acre is required to be considered significant.

*Open pollinated variety

[1] Data from 4 replications

[2] Score: 0 = no damage. 4 = severe damage

This photo shows extreme lodging. Developing corn hybrids that are resistant to lodging withou sacrificing other desirable characteristics is one of the chief aims of the corn breeder.

Table 6. Hybrid corn test at Stoneville (clay soil), 1952.

Pedigree	Acre yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Stand
	bu.	%	%	%	%
Funk G779W	30.9	90	3	7	77
Dixie 17	21.0	78	6	16	66
Pfister (PAG) 631	20.1	81	8	11	71
T0114	17.7	90	4	6	82
Dixie 82	17.2	93	4	3	79
Dixie 22	15.7	92	2	6	66
Dixie 33	15.4	70	20	10	70
T0142	15.2	80	8	12	66
T0107	13.8	89	5	6	76
Funk G711	12.2	67	12	21	66
Miss. 1123	11.8	85	2	13	65
Dixie 11	11.6	59	25	16	77
Pfister (PAG) 486	11.4	84	7	9	64
Coker 911	11.1	87	5	8	72
Station Mosby*	9.6	76	6	18	67
Pfister (PAG) 655	9.2	96	0	4	72
Jellicorse*	9.2	75	12	13	65
Funk G721	9.2	62	9	29	56
T0009	8.9	88	3	9	72
Dixie 18	8.3	71	7	22	66
Funk G785W	8.2	77	8	15	80
Coker 811	7.9	82	3	15	51
Jarvis (Sewell)*	5.4	60	16	24	49

A difference in yield of 7.7 bushels per acre is required to be considered significant.

*Open pollinated variety

Table 7. Hybrid corn test at Clarksdale, 1952.

Pedigree	Acre yield	Average yield 1950-52	Plants erect at harvest	Lodging		Earworm damage rating[3]	Ear ht.	Ears per[1] plant	Husk[2] length	Unsound ears[1]	Stand
				Roots	Stalks						
	bu.	bu.	%	%	%		ft	no.	in.	%	%
Pfister (PAG) 631	61.8	59.9	86	6	8	3.0	2.8	1.1	3.0	9	100
Funk G711	61.4		81	8	11	2.5	3.3	0.9	1.0	6	92
Miss. 1123	59.8		98	1	1	1.5	3.7	1.1	3.0	2	98
Funk G779W	58.2		86	9	5	2.0	3.6	1.0	1.0	3	93
Dixie 82	58.0		93	7	0	1.5	3.8	1.0	4.0	2	104
Funk G785W	56.7		81	14	5	1.0	3.7	0.9	2.0	2	95
T0142	54.9		95	4	1	2.0	3.6	1.0	2.0	6	90
Pfister (PAG) 486	52.7		91	5	4	1.0	3.1	0.9	2.0	3	100
T0107	51.7		99	1	0	2.0	3.7	0.8	3.0	5	98
T0009	51.5		98	1	1	3.0	3.5	0.9	3.0	14	92
Dixie 17	51.4	67.7	78	15	7	2.0	3.5	1.0	2.0	2	89
Dixie 11	49.4	64.7	67	29	4	1.0	3.5	1.1	4.0	4	91
T0114	49.3		99	0	1	2.5	3.2	0.8	2.0	3	85
Funk G721	49.3		70	15	15	2.0	3.0	1.0	2.0	8	91
Pfister (PAG) 655	48.4		97	2	1	1.5	3.5	0.8	3.0	5	102
Dixie 22	47.6	61.2	81	11	8	2.0	3.6	1.0	3.0	4	87
Coker 911	43.8		81	14	5	1.5	3.0	0.9	3.0	1	95
Dixie 33	43.4	66.3	81	18	1	2.5	3.6	0.8	2.0	3	93
Dixie 18	42.7	57.7	92	7	1	1.0	4.0	0.9	4.0	2	97
Jellicorse*	42.0	53.8	70	17	13	2.5	3.2	0.9	1.0	6	87
Coker 811	39.7	54.5	95	5	0	1.0	3.2	0.8	2.0	4	87
Station Mosby*	39.6	52.9	73	22	5	2.0	4.0	0.8	2.0	3	92
Jarvis (Sewell)*	33.3		76	14	10	2.0	2.9	0.8	2.0	6	83

A difference in yield of 11.9 bushels per acre is required to be considered significant.

*Open pollinated variety.

[1] Data from 2 replications.

[2] Data from 1 replication.

[3] Score: 0 = no damage, 4 = severe damage.

Table 8. Hybrid corn test at Pontotoc, Pontotoc Ridge, 1952.

Pedigree	Acre yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Ear ht.	Ears per plant	Husk[1] length	Stand
	bu.	%	%	%	ft.	no.	in.	%
T0114	29.5	86	11	3	4.0	1.0	3.0	96
Dixie 33	27.6	51	41	8	4.2	0.9	2.0	97
T0107	26.8	80	20	0	4.0	0.8	2.5	96
Pfister (PAG) 631	26.6	26	45	29	3.0	0.9	3.0	96
Miss. 1123	25.1	78	9	13	4.0	0.9	2.5	98
Dixie 17	24.2	62	17	21	4.0	0.9	2.0	96
Funk G711	23.4	50	16	34	4.0	0.8	2.0	98
Funk G779W	23.2	59	29	12	4.0	0.8	2.0	89
Jellicorse*	22.3	34	42	24	4.0	0.9	2.0	94
Pfister (PAG) 486	21.5	66	8	26	4.0	0.9	2.5	99
T0142	21.5	77	20	3	4.0	0.8	2.0	96
Dixie 82	21.2	83	9	8	4.2	0.8	2.5	99
Coker 911	21.2	82	11	7	3.6	0.9	2.0	96
Dixie 22	20.8	65	15	20	4.0	0.8	2.5	98
Funk G721	20.3	50	30	20	3.8	0.8	2.0	96
Dixie 11	19.5	33	54	13	4.2	0.8	2.5	95
T0009	19.4	82	10	8	4.0	0.8	2.5	96
Pfister (PAG) 655	16.9	73	24	3	4.0	0.7	2.0	96
Funk G785W	16.8	70	20	10	4.4	0.8	2.0	96
Dixie 18	12.6	65	23	12	5.0	0.6	3.0	98
Station Mosby*	12.1	39	48	13	4.8	0.6	2.5	92
Coker 811	12.0	83	8	9	3.4	0.6	2.0	96
Jarvis (Sewell)*	12.0	39	40	21	3.2	0.6	2.0	94

A difference in yield of 5.4 bushels per acre is required to be considered significant.
*Open polllinated variety.
[1] Data from two replications.

Table 9. Hybrid corn test at Pontotoc, Flatwoods, 1952.

Pedigree	Acre yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Ear ht.	Ears per plant	Husk[1] length	Stand
	bu.	%	%	%	ft.	no.	in.	%
Miss. 1123	35.4	97	1	2	5.0	1.0	3.0	99
Dixie 22	34.1	86	7	7	5.2	0.9	2.0	98
Coker 911	32.4	97	3	0	4.4	0.9	2.0	101
Pfister (PAG) 631	25.5	69	21	10	3.2	0.7	2.5	92
Dixie 11	24.9	70	28	2	4.6	0.8	2.0	101
T0114	24.8	95	3	2	4.2	0.8	2.0	98
Dixie 33	23.6	90	5	5	4.8	0.7	2.0	102
Dixie 82	22.8	94	2	4	5.2	0.8	3.0	96
Dixie 17	21.7	81	6	13	4.4	0.7	2.5	97
T0107	20.3	97	3	0	4.2	0.6	2.0	98
Coker 811	20.0	93	4	3	4.2	0.7	3.0	98
Jellicorse*	19.0	75	17	8	4.0	0.8	2.0	95
Funk G721	18.1	78	8	14	4.2	0.7	1.5	94
T0142	17.1	92	4	4	4.4	0.6	2.0	95
Dixie 18	15.5	85	8	7	5.2	0.6	3.5	99
Pfister (PAG) 486	13.1	92	2	6	4.0	0.6	2.0	98
Funk G785W	13.1	69	8	23	4.6	0.6	2.0	90
Pfister (PAG) 655	12.6	96	4	0	4.6	0.5	3.0	101
Funk G779W	12.6	78	10	12	3.8	0.6	2.0	95
T0009	11.8	84	4	12	4.4	0.5	3.0	94
Jarvis (Sewell)*	11.6	73	14	13	3.6	0.5	2.5	89
Funk G711	9.4	85	4	11	4.0	0.4	2.0	92
Station Mosby*	6.7	69	20	11	5.0	0.3	2.5	98

A difference in yield of 9.0 bushels per acre is required to be considered significant.
*Open pollinated variety. [1] Data from two replications.

Table 10. Average of data from hybrid corn tests grown at Brooksville, Newton, Raymond and Yazoo City.

Pedigree	Acre yield	Average yield 1950-52	Plants erect at harvest	Lodging		Ear ht.	Ears[1] per plant	Stand
				Root	Stalk			
	bu.	bu.	%	%	%	ft.	no.	%
Dixie 33	26.8	54.3	67	25	8	4.0	1.0	82
Dixie 17	26.3	55.3	71	12	17	3.6	0.9	80
Dixie 22	25.4	50.4	76	13	11	3.8	0.8	78
Pfister (PAG) 631	25.4	47.8	61	19	20	3.0	0.8	80
Coker 911	22.2		89	8	3	3.4	0.8	87
Miss. 1123	22.0		86	4	10	4.1	0.8	86
Pfister (PAG) 486	21.7		83	7	10	3.3	0.9	81
Funk G721	20.6		59	20	21	3.6	0.8	79
Dixie 11	19.8	49.5	57	31	12	4.1	1.0	84
Dixie 82	19.3		88	5	7	4.0	0.8	76
Coker 811	19.2	46.0	90	6	4	3.4	0.8	78
Jellicorse*	18.1	43.7	66	19	15	3.4	0.8	79
Dixie 18	17.6	46.6	80	13	7	4.3	0.8	84
Pfister (PAG) 655	16.8		86	10	4	3.8	0.7	81
Funk G785W	14.1		76	15	9	3.9	0.7	81
Funk G714A	12.9	44.0	75	12	13	3.3	0.7	76
Station Mosby*	12.2	42.0	67	19	14	4.6	0.6	79
Ga. 281	6.8		85	7	8	4.8	0.6	82

*Open pollinated variety.

[1] Three station average.

Table 11. Hybrid corn test at Brooksville, 1952

Pedigree	Acre yield	Average yield 1949, 50-51	Plants erect at harvest	Lodging		Ear ht.	Ears per plant	Stand
				Root	Stalk			
	bu.	bu.	%	%	%	ft.	no.	%
Dixie 33	35.3	56.5	57	41	2	4.0	1.0	86
Dixie 22	33.5	57.6	80	17	3	4.0	0.9	86
Pfister (PAG) 631	32.4	51.0	54	39	7	3.0	0.9	85
Pfister (PAG) 486	29.0		94	4	2	3.0	1.0	85
Miss. 1123	27.7		94	3	3	4.0	0.9	87
Coker 911	25.3		85	12	3	3.2	0.8	85
Funk G721	24.5		48	35	17	3.2	0.8	82
Dixie 17	24.0	54.1	75	12	13	3.2	0.8	89
Dixie 82	23.6		88	9	3	4.0	0.8	91
Pfister (PAG) 655	22.1		89	11	0	4.0	0.8	94
Dixie 11	20.9	50.0	50	46	4	3.8	0.8	89
Jellicorse*	17.4	45.4	62	26	12	3.2	0.7	88
Coker 811	19.4		88	12	0	3.0	0.7	91
Funk G785W	15.6		80	17	3	4.0	0.6	89
Dixie 18	15.0	44.6	78	19	3	4.2	0.7	86
Funk G714A	13.3		79	14	7	3.2	0.6	78
Station Mosby*	11.6	41.2	55	34	11	4.6	0.5	85
Ga. 281	6.2		84	13	3	4.8	0.4	84

A difference in yield of at least 5.7 bushels per acre is required to be considered significant.

*Open pollinated variety.

Table 12. Hybrid corn test at Newton.

Pedigree	Acre yield	Average yield 1950-52	Plants erect at harvest	Lodging		Ear ht.	Stand
				Root	Stalk		
	bu.	bu.	%	%	%	ft.	%
Dixie 33	25.4	46.3	74	16	10	4.0	96
Pfister (PAG) 631	23.4	41.3	35	3	62	3.0	96
Dixie 17	22.9	46.1	64	1	35	4.0	97
Miss. 1123	22.8		71	0	28	4.2	99
Coker 811	20.8	39.5	90	3	7	3.6	98
Pfister (PAG) 486	20.4		70	5	25	3.4	98
Dixie 22	20.2	40.2	57	8	35	4.0	95
Funk G721	19.0		52	10	38	4.0	98
Hollomon Cribfiller*	17.3		45	7	48	2.4	92
Jellicorse*	17.1	39.9	60	4	36	3.6	97
Coker 911	16.6		92	2	6	3.8	98
Jarvis (Sewell)*	16.6		52	7	41	3.0	95
Dixie 82	16.3		80	0	20	4.4	98
Dixie 11	15.8	39.2	53	32	15	4.6	96
Pfister (PAG) 655	15.4		75	14	11	4.0	99
Dixie 18	10.9	36.5	80	4	16	4.6	97
Funk G785W	10.6		68	13	19	4.2	94
Funk G714A	8.9	36.8	67	7	26	3.4	95
Station Mosby*	8.6	34.5	72	13	15	5.2	92
Ga. 281	5.2		92	2	6	5.6	96

A difference in yield of at least 4.6 bushels per acre is required to be considered significant.
*Open pollinated variety.

Table 13. Hybrid corn test at Raymond, 1952.

Pedigree	Acre yield	Average yield 1950-52	Plants erect at harvest	Lodging		Ear ht.	Ears per plant	Stand
				Root	Stalk			
	bu.	bu.	%	%	%	ft.	no.	%
Coker 911	29.3		80	18	2	3.6	1.1	79
Dixie 17	26.1	57.9	59	28	13	3.5	1.2	62
Miss. 1123	24.4		85	11	4	4.0	1.1	68
Pfister (PAG) 486	22.9		71	19	10	3.1	1.1	62
Dixie 18	22.5	49.4	68	26	6	3.9	1.0	67
Dixie 22	21.4	49.4	69	28	3	3.5	1.0	44
Dixie 33	21.4	51.8	44	39	17	3.8	1.1	60
Pfister (PAG) 631	19.6	41.7	63	32	5	2.7	0.9	61
Dixie 82	19.3		91	8	1	3.5	1.1	42
Funk G721	18.1		55	25	20	3.4	1.0	57
Dixie 11	17.5	51.6	34	40	26	3.9	1.3	65
Coker 811	16.8	43.7	82	11	7	3.5	1.2	50
Station Mosby*	15.3	44.6	54	24	22	4.2	0.9	60
Pfister (PAG) 655	15.2		83	14	3	3.5	1.0	48
Funk G785W	15.2		66	26	8	3.3	0.9	58
Jellicorse*	14.7	42.1	58	35	7	3.5	0.9	58
Ga. 281	11.6		70	13	17	3.8	1.0	55
Funk G714A	9.9	47.3	68	21	11	2.9	0.9	51

A difference in yield of at least 6.0 bushels per acre is required to be considered significant.
Open pollinated variety.

Table 14. Hybrid corn test at Yazoo City, 1952.

Pedigree	Acre yield	Average yield 1949, 50 & 52	Plants erect at harvest	Lodging Root	Lodging Stalk	Earworm damage rating[3]	Ear ht.	Ears[2] per plant	Unsound ears[1]	Stand
	bu.	bu.	%	%	%		ft.	no.	%	%
Dixie 17	32.2	76.4	89	5	6	2.0	3.7	0.8	2	74
Dixie 22	26.7	70.8	98	0	2	1.5	3.9	0.6	3	88
Pfister (PAG) 631	26.2	70.0	95	1	4	2.0	3.5	0.6	18	76
Dixie 33	25.0	69.4	92	4	4	2.0	4.0	0.8	1	87
Jellicorse*	23.1	61.1	83	11	6	2.0	3.5	0.7	7	72
Dixie 11	22.9	81.0	90	5	5	1.0	4.0	0.8	0	87
Dixie 18	22.0	74.7	94	4	2	1.0	4.4	0.6	0	87
Funk G721	20.9		80	10	10	2.5	3.6	0.5	2	79
Coker 811	19.8		100	0	0	0.5	3.4	0.6	2	73
Funk G714A	19.5		86	5	9	2.5	3.6	0.6	4	80
Dixie 82	18.0		95	2	3	1.5	4.3	0.6	5	75
Coker 911	17.7		97	1	2	1.5	3.2	0.5	0	87
Funk G785W	15.1		89	5	6	1.0	4.1	0.5	5	82
Pfister (PAG) 655	14.6		100	0	0	1.5	3.7	0.4	19	83
Pfister (PAG) 486	14.4		94	1	5	1.5	3.6	0.5	0	80
Miss. 1123	13.2		97	0	3	2.0	4.2	0.5	6	89
Station Mosby*	13.1	62.7	84	6	10	2.0	4.5	0.3	4	79
Ga. 281	4.2		95	0	5	2.0	5.0	0.3	0	91

A difference in yield of at least 9.8 bushels per acre is required to be considered significant.

*Open pollinated variety

[1] Data from 2 replications.

[2] Data from 3 replications.

[3] Score: 0 = no damage, 4 = severe damage.

Table 15. Hybrid corn test at Poplarville, 1952.

Pedigree	Acre yield	Average yield 1950-52	Plants erect at harvest	Lodging		Ears infested[1]		Ear ht.	Ears per plant	Husk length	Shell-ing[2]	Moist. in grain[2]	Stand
				Root	Stalk	Rice weevil	Earworm						
	bu.	bu.	%	%	%	%	%	ft.	no.	in.	%	%	%
Dixie 11	39.5	48.5	56	28	16	32	41	4.0	1.4	2.3	85	16.1	97
Coker 911	38.7		89	6	5	42	60	3.3	1.1	2.2	84	16.0	99
Dixie 17	38.3	48.6	57	14	29	68	79	4.0	1.2	1.8	84	16.5	99
Miss. 1123	35.6		94	0	6	51	76	4.0	1.1	2.8	81	16.4	97
Dixie 22	34.0	44.1	83	3	14	64	82	3.8	1.1	2.3	80	16.8	98
Dixie 33	32.2	40.9	84	4	12	71	85	3.2	1.0	2.2	83	16.4	94
Coker 811	31.5	49.7	97	2	1	21	41	3.5	1.1	2.0	81	16.4	99
Dixie 82	31.2		92	3	5	43	74	4.0	1.0	2.2	81	16.4	97
La. 521	30.0		76	14	10	20	34	4.8	1.0	2.0	84	17.8	98
Dixie 18	29.3	50.2	90	4	6	26	35	4.7	1.0	3.0	83	16.8	98
Ga. 281	28.9		77	15	8	7	24	5.5	1.1	3.5	83	17.5	100
Station Mosby*	27.1	42.9	54	24	22	61	62	4.8	0.9	2.0	81	16.6	97
Funk G791W	26.7	41.6	48	20	32	30	49	4.5	1.0	3.0	82	16.8	94
Funk G737	21.2	36.7	76	10	14	37	52	4.0	0.9	2.2	78	16.8	96
Local Var. Shoe Peg*	17.6		69	13	18	14	51	4.3	0.7	3.5	87	16.4	98

A difference in yield of at least 5.4 bushels per acre is required to be considered significant.

*Open pollinated variety.

[1] Data from 5 replications.

[2] Data from 4 replications.

BULLETIN 499 JANUARY 1953

MISSISSIPPI

COTTON VARIETY TESTS

1952

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

1952 Cotton Variety Tests
IN HILL SECTIONS

By J. F. O'KELLY, S. P. CROCKETT, B. C. HURT and K. C. FREEMAN

The tests here reported received a poor start because of low temperatures and, in some cases, low soil moisture at planting time. Later there was seldom sufficient moisture for normal plant growth and this moisture deficiency was most acute during the fruiting season. As a result of the heat and dryness, weed and insect control were relatively easy.

The seed used in these tests were obtained, in all cases, from the originators.

The computation of total acre-values was based on $70 a ton for seed and the average price of lint on the Memphis market for the various staple lengths for ten weeks of the marketing season beginning with the last week of August.

A study of the averages will provide the best measure of the merits of the commonly used varieties but the current year's results will also be of interest especially in the case of new varieties.

Among the interesting new varieties are Plains and Hybrid 56 which are good producers and resist fusarium wilt. Fox is an excellent early variety.

The test at Holly Springs was fertilized with 600 pounds of 8-8-4 April 17 and was planted May 6. The slightly less than normal yields were due to low soil moisture and not to insects.

The test on Flatwoods soil at Pontotoc was fertilized with 600 pounds of 12-8-6 before planting and sidedressed with 100 pounds ammonium nitrate. It was planted May 1 but germination was delayed until June 1.

The severity of the drouth was most evident in the results of the test at Newton. There was heavy shedding of squares and bolls for about 40 days. The yields are too low for the varieties to give a clear expression of their productiveness. The fertilizer used was 600 pounds of 12-8-8 to the acre applied before planting.

At State College a few light showers reduced the severity of the drouth somewhat. The test was fertilized with 600 pounds of 6-8-4 before planting and planted April 26. No attempt was made to control thrips and damage from this insect was severe. Five sprayings with toxaphene together with the drouth kept the boll weevil under fair control.

The varieties tested which are resistant to fusarium wilt include Coker, Wilt; Empire; Plains; and Hybrid 56. Farmers having a considerable acreage of wilt infected soil should consider one of these. Otherwise nearly any one of the varieties in this group will give satisfactory production over a period of several years.

Average results from cotton varieties, State College

	Pounds lint per acre					Averages				
	1948	1949	1950	1951	1952	Lint	Acre value	Lint percentage	Staple inches	Bolls per lb. lint
Deltapine 15	743	345	556	523	601	554	230.24	40.3	1 1/16	183
Delfos 7343	710	339	431	532	615	525	225.60	37.1	1 3/32	196
Miller	730	308	465	516	602	524	214.99	37.7	31/32	172
Coker, Staple	709	347	436	485	627	521	224.00	36.6	1 3/32	196
Delfos 9169	694	361	360	477	668	512	215.95	36.5	1 3/32	182
Coker, Wilt	707	343	411	509	586	511	215.37	36.9	1 1/16	185
Bobshaw 1A	723	381	396	442	556	499	206.76	36.8	1 1/16	195
Stoneville 2B	727	300	347	455	632	492	203.48	37.2	1 1/16	177
Empire	678	387	307	503	568	488	201.78	37.6	1 1/16	161
Hi-Bred	685	340	336	548	520	486	187.04	42.0	29/32	148

Average results from cotton varieties, Newton.

	Pounds lint per acre					Averages				
	1948	1949	1950	1951	1952	Lint	Acre value	Lint per-centage	Staple inches	Bolls per lb. lint
Bobshaw 1A	472	245	556	452	160	377	157.74	37.9	1 1/32	235
Stoneville 2B	499	267	518	411	168	373	157.01	37.9	1 1/32	210
Coker, Wilt	490	258	510	410	166	367	152.54	37.5	1 1/32	229
Hi-Bred	515	274	420	467	154	366	135.93	42.8	27/32	191
Empire	459	283	577	336	164	364	151.64	39.1	1 1/32	194
Deltapine 15	460	308	529	331	137	353	144.42	41.2	1 1/32	223
Miller	502	191	495	412	151	350	144.47	38.2	31/32	217
Delfos 9169	451	233	474	367	155	336	142.90	37.6	1 1/16	215
Coker, Staple	450	181	464	372	166	327	139.74	37.2	1 1/16	249
Delfos 7343	434	223	414	377	142	318	133.09	38.0	1 1/16	244

Average results from cotton varieties, Holly Springs.

	Pounds lint per acre					Averages				
	1948	1949	1950	1951	1952	Lint	Acre value	Lint per-centage	Staple inches	Bolls per lb. lint
Delfos 9169	732	563	568	456	447	553	229.87	37.1	1 1/16	187
Coker, Staple	731	547	566	374	435	530	219.89	37.4	1 1/16	204
Stoneville 2B	756	457	518	430	460	524	217.42	37.4	1 1/32	183
Deltapine 15	690	551	526	399	452	524	211.23	40.7	1	197
Empire	708	565	502	381	456	522	212.93	39.1	1 1/32	168
Coker, Wilt	703	514	573	406	414	522	215.34	37.9	1 1/32	189
Miller	742	498	484	408	405	507	201.54	38.6	15/16	183
Hi-Bred	746	528	426	411	415	505	190.46	42.5	7/8	156
Delfos 7343	688	496	478	436	409	502	207.02	37.9	1 1/32	205
Bobshaw 1A	657	447	534	424	439	500	205.33	37.7	1	206

Cotton varieties, Holly Springs, 1952.

	Pounds lint per acre	Total acre value			Lint percent-age	Staple inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Hybrid 56	484.1	208.22	200.23	180.87	38.2	15/16	219
Fox	466.1	200.75	193.06	177.91	38.8	31/32	230
Stoneville 2B	459.9	201.25	193.89	180.56	37.4	1	203
Empire	456.3	192.04	184.51	166.26	42.5	15/16	171
Arkot 2-1	453.4	198.63	191.37	178.23	37.2	1	222
Deltapine 15	452.0	191.49	184.03	169.34	42.1	31/32	203
Plains	450.5	193.17	185.73	171.10	39.6	31/32	199
Delfos 9169	447.1	197.55	190.85	177.66	37.5	1 1/32	194
Bobshaw 1A	439.0	189.59	182.35	168.08	38.3	31/32	231
Coker, Staple	434.9	189.88	182.92	170.31	37.8	1	218
Hi-Bred	415.3	159.93	155.78	147.47	43.7	25/32	165
Coker, Wilt	414.2	178.30	171.47	158.01	38.9	31/32	199
Delfos 7343	409.4	173.43	166.67	153.37	42.1	31/32	220
Miller	404.6	168.00	162.74	148.17	38.8	7/8	200
Stoneville 5A	377.7	157.44	152.53	138.56	40.3	39/32	228
Northern Star	375.7	160.97	154.77	139.75	38.9	15/16	191

Cotton varieties, State College, 1952

	Pounds lint per acre	Total acre value			Lint percentage	Staple inches	Bolls per. lb. lint
		Middling	Strict low middling	Low middling			
Delfos 9169	668.1	295.36	285.33	265.63	37.4	1 1/32	190
Plains	640.2	277.98	267.73	249.17	38.8	1	180
Stoneville 2B	632.1	275.36	265.24	246.91	38.2	1	186
Stoneville 5A	630.6	271.31	260.91	240.41	39.0	31/32	206
Coker, Staple	626.6	279.12	269.72	251.24	36.1	1 1/32	212
Delfos 7343	614.9	267.96	258.74	240.60	40.1	1 1/32	201
Hybrid 56	605.6	265.61	255.92	238.36	37.0	1	204
Miller	601.7	258.80	248.88	224.81	38.2	15/16	176
Deltapine 15	601.4	259.95	250.93	233.18	41.8	1 1/32	188
Coker, Wilt	585.8	258.82	250.04	232.76	37.5	1 1/32	193
Empire	568.5	246.84	237.75	221.26	38.8	1	163
Fox	565.3	245.59	236.54	220.15	38.7	1	227
Northern Star	562.6	241.54	232.25	213.97	39.4	31/32	167
Arkot 2-1	575.8	253.59	244.38	227.68	36.3	1	204
Bobshaw 1A	555.8	243.63	234.74	218.62	37.1	1	207
Hi-Bred	520.2	209.51	203.79	184.54	42.3	27/32	157

Cotton varieties, Newton, 1952

	Pounds lint per acre	Total acre value			Lint percentages	Staple inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Hybrid 56	204.7	88.16	84.79	78.13	38.8	31/32	225
Arkot 2-1	183.2	81.47	78.72	73.31	36.4	1 1/32	279
Stoneville 5A	181.4	77.52	74.52	68.63	40.3	31/32	281
Stoneville 2B	167.9	73.42	70.74	65.87	37.5	1	247
Coker, Staple	166.5	73.61	71.12	66.20	37.4	1 1/32	301
Coker, Wilt	165.7	73.34	70.85	65.96	37.2	1 1/32	276
Empire	164.3	71.00	68.37	63.61	39.7	1	229
Plains	164.1	70.53	67.82	62.49	39.2	31/32	290
Bobshaw 1A	159.8	68.64	66.01	60.81	39.3	31/32	281
Delfos 9169	155.4	68.48	66.14	61.56	38.0	1 1/32	263
Hi-Bred	154.3	58.14	56.60	53.51	42.8	3/4	251
Fox	152.6	66.56	64.11	59.69	38.0	1	298
Miller	151.2	63.79	61.82	56.23	38.1	29/32	268
Delfos 7343	142.4	61.99	59.85	55.65	40.3	1 1/32	312
Northern Star	138.3	59.63	57.35	52.85	38.6	31/32	254
Deltapine 15	137.2	58.63	56.43	52.45	42.0	1	249

Cotton varieties, Pontotoc, Flatwoods Soil, 1952.

	Pounds lint per acre	Total acre value			Lint percentage	Staple inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Hi-Bred	387.9	146.30	142.42	134.66	42.6	23/32	168
Plains	355.3	148.81	144.20	131.05	39.4	29/32	186
Fox	346.5	146.01	141.51	128.69	38.3	29/32	225
Stoneville 2B	343.8	148.73	143.05	131.88	38.0	31/32	188
Hybrid 56	334.6	141.07	136.72	124.34	38.2	29/32	197
Arkot 2-1	334.2	145.66	140.15	129.29	36.7	31/32	207
Bobshaw 1A	326.5	141.72	136.33	125.72	37.4	31/32	215
Stoneville 5A	326.3	135.18	130.94	119.19	39.2	7/8	209
Empire	323.7	137.69	132.35	119.40	40.3	15/16	149
Miller	308.0	126.78	123.39	112.00	38.2	27/32	188
Deltapine 15	302.1	127.73	122.75	110.67	41.5	15/16	202
Delfos 9169	300.4	132.80	128.30	119.44	37.4	1 1/32	179
Coker, Wilt	300.1	130.20	125.25	115.49	37.5	31/32	204
Delfos 7343	298.3	126.76	121.83	109.90	40.5	15/16	214
Northern Star	292.6	126.02	121.19	111.68	38.8	31/32	171
Coker, Staple	287.6	127.43	123.12	114.64	37.0	1 1/32	206

IN THE DELTA

By JAMES B. DICK and ZANE F. LUND

Four standard cotton variety yield trials were conducted by the Delta Branch Experiment Station in 1952 on the Station and at other locations in cooperation with Delta farmers. One of these trials was on "buckshot" soil near Tunica. Two variety trials designed for large scale fully mechanized production, were planted at Kelso and Stoneville. The Kelso test gave very valuable information but poor stands in the Stoneville test prevented using it for yields.

Cotton is a hot weather plant, but the far-above-average temperatures of June and July, coupled with the scant rainfall of May, June and July, greatly reduced the yield in many parts of the Delta. Limited areas, like the Clarksdale territory, which received rainfall in early July produced excellent yields of cotton.

Of the six Delta cotton variety tests three had to be replanted because of unfavorable conditions and seedling diseases in late April. The test near Yazoo City received no rainfall during the season, had fair average stands with small stalks, and averaged about 300 pounds of lint per acre. The Tunica test, planted on buckshot soil, likewise received no rainfall but produced a 390-pound average. The Money test area had adequate rainfall and the test there averaged 885 pounds per acre. The test at Stoneville, planted partly on deep sandy soil, suffered badly in July but recovered somewhat with the cooler weather of early August and averaged a bale per acre.

Heavy rains in early August delayed maturity somewhat in the Kelso area, but greatly improved cotton yields. The test at Kelso was cross-plowed on 40-inch centers and had very good stands throughout. The average yield of the nine varieties planted was approximately 870 pounds of lint per acre.

Grades for Delta cottons have been

Table 1. Results of cotton variety yield trials Yazoo-Mississippi Delta, 1952.

Variety	Yield per acre		Gin turn out
	Seed cotton	Lint	
	Lbs.	Lbs.	Pct.
STONEVILLE			
Fox	1641	603	36.8
Deltapine 15	1496	570	38.1
Delfos 9169	1506	534	35.4
DES 7343	1311	502	38.4
Stoneville 2B	1427	492	34.6
Empire	1325	491	37.0
Arkot	1400	488	34.9
Miller	1306	466	35.8
Coker 100 Wilt	1292	460	35.5
Bobshaw 1A	1338	442	33.0
Wilds	1231	403	32.7
Planted May 7, first picking September 9			
YAZOO CITY			
Fox	969	356	36.7
Delfos 9169	1006	348	34.6
Bobshaw 1A	946	335	35.4
Empire	875	320	36.6
DES 7343	838	312	37.2
Coker 100 Wilt	909	311	34.2
Stoneville 2B	892	311	34.9
Deltapine 15	779	308	39.6
Arkot	864	301	34.8
Miller	768	278	36.2
Wilds	598	194	32.4
Planted April 18, harvested September 23			
MONEY			
Delfos 9169	2886	998	34.6
Deltapine 15	2489	983	39.5
Bobshaw 1A	2766	979	35.4
Fox	2592	938	36.2
Stoneville 2B	2592	904	34.9
DES 7343	2341	883	37.7
Coker 100 Wilt	2483	849	34.2
Miller	2283	826	36.2
Wilds	2553	802	31.4
Empire	2195	792	36.1
Arkot	2293	784	34.2
Planted May 3, first picking September 30			
TUNICA BUCKSHOT			
Deltapine 15	1224	502	41.0
Delfos 9169	1224	428	35.0
Stoneville 2B	1221	418	34.5
Fox	1111	402	36.2
Arkot	1116	391	33.7
Coker 100 Wilt	1135	387	34.1
Bobshaw 1A	1106	385	34.8
Coker 100 Staple	1100	372	33.8
Miller	1006	367	36.5
DES 7343	964	366	38.0
Empire	1001	360	35.9
Wilds	1038	326	31.4
Planted April 28, first picking August 28			

above the average and much machine-picked cotton has graded middling. The strength of the 1952 Delta crop has been excellent. Dry weather prevented full expression of staple length and that fiber character is a little shorter than normal.

Boll weevil infestation throughout the season was generally light. Boll worm infestation was heavy, but the overall damage to the crop was relatively light and spotted.

All varieties in the yield trials were the current improved strains of the reliable breeders or firms whose cottons are commonly grown on a large percentage of the Delta cotton acreage. Varieties are listed in each test in order of yield of lint per acre.

Yields of seed cotton and of lint per acre and gin turnout are given for the five tests. The data is presented as a progress report.

Table 2. Yield and gin turnout of nine varieties in a yield trial on Kelso Plantation, conducted under full mechanized practices, 1952.

Variety	Yield per acre		Gin turn out
	Seed cotton	Lint	
	Lbs.	Lbs.	Pct.
SLS 1001	2482	1020	41.1
Deltapine 15	2350	917	39.0
Fox	2408	896	37.2
Stoneville 2B	2430	892	35.8
DES 7343	2287	880	38.5
Coker 100 Wilt	2433	866	35.6
Bobshaw 1A	2279	855	37.5
Delfos 9169	2327	845	36.3
Empire	1973	730	37.0

Planted May 2, harvested October 30

BULLETIN 500 JUNE 1953

AN ECONOMIC APPRAISAL OF
HOG PRODUCTION
IN THE SHORTLEAF PINE AREA OF MISSISSIPPI

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

LIST OF TABLES

Table Page

1. Investment in the hog enterprise 9
2 Costs of the hog enterprise 10
3. Returns to the hog enterprise 11

Appendix Tables

1. Land use 14
2. Cropland utilization 14
3. Other livestock enterprise of commercial importance 14
4. Age and sex distribution of family labor force 14
5. Age of operators 14
6. Hours of labor used for the hog enterprise per farm, per sow, and per hundredweight of pork produced 15
7. Labor cost for the hog enterprise per farm, per sow, and per 100 pounds of pork produced 15
8. Power and equipment used 15
9. Buildings used in connection with the hog enterprise 16
10. Building cost for the hog enterprise farm, per sow, and per 100 pounds of pork produced 16
11. Hog numbers per farm 16
12. Percentage of pigs born, pigs purchased, feeder hogs purchased, pigs sold and hogs sold, by months 17
13. Health practices 17
14. Causes of death of animals 17
15. Pounds and value of pork sold per farm 18
16. Pounds and value of pork produced per farm, per sow and per 100 pounds of pork produced 18
17. Quantities and value of feed used by the hog enterprise per farm and per 100 pounds of pork produced 18
18. Land preparation, fertilization, and seeding practices, improved permanent pasture grazed by hogs 19
19. Annual land preparation, fertilization, and seeding practices, temporary winter pasture grazed by hogs 19
20. Cost of establishment and annual cost per acre, improved permanent pasture grazed by hogs 20
21. Annual pasture cost per acre, improved permanent, woodland, temporary winter and temporary summer 20
22. Acres and cost of pasture used by the hog enterprise per farm 20
23. Pasture credit per acre and per farm for the hog enterprise 21
24. Replacement cost and annual cost of one mile of permanent fence 21
25. Sources of water for the hog enterprise 21
26. Cost of marketing hogs 22
27. Miscellaneous costs of the hog enterprise 22
28. The corn-hog ratio for Mississippi for the year studied compared with the average corn-hog ratio for Mississippi for the 5-year period beginning July 1947 and ending June 1952 22

TABLE OF CONTENTS

Page

List of Tables 3

Introduction 5

  The Problem 5

  Method of Study 5

System of Farming

  Land Use 5

  Cropping Pattern 5

  Livestock System 6

  Farm Labor Supply 6

  Farm Equipment 6

  Farm Buildings 6

Management Practices

  Feeding Practices 6

  Grazing Practices 6

  Breeding Practices 8

  Buying and Selling Hogs 8

  Health Practices 8

  Labor Utilization 9

Investment, Costs and Returns

  Investment 9

  Costs 10

  Returns 10

Conclusions 11

Appendix I, Methods Used in Calculating Investment, Costs and Returns 12

Appendix II, Statistical Tables 14

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AN ECONOMC APPRAISAL OF HOG PRODUCTION IN THE SHORTLEAF PINE AREA OF MISSISSIPPI

By D. W. PARVIN

The Problem: Hog production has been increasing in importance in Mississippi for the past quarter of a century. The relative contribution of hogs to Mississippi cash farm income has increased consistently from 1.7 percent of the total for the five-year period 1925-1929 to 3.7 percent for the five-year period 1945-1949.[1] The production of more corn[2] and relatively high prices for pork during recent years are the major factors contributing to the increase in pork production in Mississippi; also, a decline in the farm labor supply, relatively low labor requirements for pork production, and the low investment requirements were contributing factors on many farms.

It is expected that the production of corn in Mississippi will continue to increase because per-acre yields are much below those that can be profitably produced by the use of practices developed by Experiment Station agronomists. Also, it is expected that the demand for meat will continue at a high level and that there will continue to be a shortage of farm labor. Therefore, further increases in pork production on Mississippi farms may be expected. Farmers contemplating adding a hog enterprise to their present system of farming, or expanding their present hog enterprise, need certain basic information on which to base their decisions. This study was designed to provide such information. Specifically, the objectives of this study are:

1. To determine the resources used in pork production and the investment required.
2. To determine costs and returns.
3. To study present management practices and to suggest ways whereby pork production can be made more profitable.

Method of Study: Data for the study were obtained by personal interview with 46 producers in the Mixed Brown Loam and Sand Clay Hills soil areas of Alcorn, Calhoun, Lauderdale, and Leake counties. A list of hog producers was secured from the Agricultural Extension Service and supplemented by agricultural workers in each county. As far as possible,[3] all hog producers who sold 10 or more animals during the year studied were interviewed. Detailed information, with regard to all phases of the hog enterprise, was obtained. Methods used in calculating investment, costs and returns are given in Appendix I.

System of Farming

Land Use: Farms having hog enterprises of commercial importance were about twice as large as the average operating unit in the area studied, 240 acres compared to about 140 acres[4] (Appendix Table 1). On the farms studied, the land area was almost equally divided between open land and woodland; there was slightly more open land. Of each three acres of open land, approximately two acres were used for crops and one acre for permanent pasture. One-half of the woodland was grazed.

Cropping Pattern: Approximately one-half of the cropland was planted to corn. Hay crops and cotton accounted for most of the balance, 22.1 percent and 16.8 percent of the total cropland, respectively. Temporary grazing crops and oats for grain were grown on some farms. Six percent of the cropland was idle and 11 percent was double-cropped.

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[1] It was 2.2 percent for 1930-1934, 2.7 percent for 1935-39, and 3.5 percent for 1940-44. **Agricultural Statistics,** USDA.

[2] Mississippi farmers produced 30 percent more corn from 1945 through 1949 than they did from 1925 through 1929. **Agricultural Statistics,** USDA.

[3] If an interview was not obtained in three visits to a farm, that producer was dropped from the study.

[4] Estimates based on census of 1945 and 1950.

Livestock System: About two-thirds of the producers had been in commercial hog production 10 years or less. Commercial livestock production was limited to the production of hogs on approximately one-half of the farms studied. In addition to the hog enterprise, 41 percent of the farms had a beef enterprise, 11 percent had a dairy enterprise, and 4 percent had a poultry enterprise (Appendix Table 3).

There was an average of 4.3 sows per farm; 46 hogs were sold per farm (Appendix Table 11). In addition, for all farms studied, an average of 10 beef animals were sold, 4 dairy cows milked, and 55 laying hens kept per farm.

Farm Labor Supply: Including the operator, there was an average of 4.2 persons in the family labor force per farm (Appendix Table 4). There were slightly more males than females and about one-half of the family labor force was between the ages of 18 and 60. Only 4 of the 46 operators were under 30 years of age (Appendix Table 5).

In addition to the family labor force, 39 percent of the operators had share croppers and 63 percent hired some wage workers. For all farms studied, 56 percent of the cotton and 31 percent of the corn was worked by croppers. In addition an average of 72 days of wage labor was hired per farm, of which about two-thirds was hired by the day.

Farm Equipment: Thirty of the 46 farms used both tractors and mules as sources of power, 13 used mules only, and 3 used tractors only (Appendix Table 8). Cultivating equipment was found on all farms, disks on 87 percent, breaking plows on 87 percent, mowers on 85 percent, rakes on 74 percent, lime spreaders on 46 percent, and hay balers on 26 percent of the farms.

Farm Buildings: The general barn was used in connection with the hog enterprise on 33 of the 46 farms studied (Appendix Table 9). A general hog barn was used on 9 farms. Cribs or grain storage facilities, separate from the general barn and general hog barn, were used on 12 farms. Individual farrowing houses were used on 11 farms and central farrowing house on 5 farms.

Management Practices

Feeding Practices: Eighty-nine percent of the average hog ration was corn, of which 1 bushel out of 7 was hogged off (Appendix Table 17). Protein supplement (including tankage, cottonseed meal, soybean meal, commercial supplement, crushed soybeans, and soybeans hogged off) accounted for 8.6 percent of the total hog ration. Six of the 46 producers did not feed supplement, and on only 8 farms did protein supplement constitute for each hundred pounds of pork produced.

Grazing Practices: The acreage of pasture used by the hog enterprise was relatively large. A total of .72 acres of improved permanent pasture,[5] .36 acres of unimproved permanent pasture, .82 acres of temporary winter pasture, .02 acres of temporary summer pasture, and 1.10 acres of woodland pasture was grazed per sow and litter or litters (Appendix Table 22).

About half of the producers had made some improvement on open permanent pasture. A complete job of improvement (land preparation, fertilization, and seeding) had been done on 23 percent of the improved permanent pasture. Seventy-five percent of the total acreage of improved permanent pasture had been improved by either land preparation, fertilization, or seeding or by a combinaion of any two of these practices; 2 perent had been improved by mowing nly.

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[5] Open permanent pasture where the land had been broken, seeded or fertilized or any combination of these practices. Open permanent pasture that had been mowed every year for the four years immediately preceding the year studied was also classified as being improved.

Relatively little land preparation and eeding was done in improving permannt pastures. Of the total acreage of mproved pasture, less than one-third was roken and less than one-fourth seeded n the process of improvement. (Appenlix Table 18.) Common lespedeza, White utch clover, Dallis grass, fescue, crimon clover, and black medic were the nly pasture plants seeded.

Fertilization and mowing were the nethods most commonly used in improvng permanent pastures. Fertilizers (not ncluding lime) had been applied to 89 ercent of the total acreage of improved ermanent pasture; lime had been aplied to 14 percent of the acreage. Suerphosphate had been applied to 57 ercent of the total acreage of improved ermanent pasture, basic slag to 56 perent, and potash to 32 percent.[6] Most f the improved permanent pasture was nowed. Of the total acreage of improvd permanent pasture, 88 percent was nowed an average of 1.6 times during he year studied.

Temporary winter pasture was providd for the hog enterprise on 14 of the 6 farms and averaged approximately 2 cres per sow and litter or litters on these arms. Several combinations of winter razing crops were used. However, oats lone or in combination with one or more egumes accounted for 89 percent of the otal acreage (Appendix Table 19). Wild inter peas, vetch, and crimson clover ere the legumes seeded with oats.

In planting temporary winter grazing rops, considerable time was spent in the reparation of the seedbed. Of the tol acreage of winter grazing crops, 97 ercent was disked an average of 1.85 mes per acre, 19 percent was flat-broken, and 73 percent was harrowed an average of 1.8 times per acre.

Fertilizers were applied to 80 percent of the total acreage of temporary winter pastures. Phosphate and potash were the fertilizers most commonly used. Phosphate was applied to 74 percent of the acreage at the rate of 68 pounds P_2O_5 per acre and potash to 27 perceent of the acreage at the rate of 50 pounds of K_2O per acre. Basic slag was applied to 9 percent of the acreage, nitrogen to 4 percent, and mixed fertilizer to 1 percent.

Temporary summer pasture was provided for the hog enterprise on 3 of the 46 farms and averaged one-fourth acre per sow on these farms. Sudan was the crop used on two farms and lespedeza on the other farm.

The usual practice was to give all or part of the hogs access to permanent pasture the year around. On the average, grazing on temporary winter pasture was begun the middle of December and continued until the middle of March. On most farms the hogs were given access to the temporary winter pasture throughout the period grazed; however, in a few cases the hogs were taken off of the grazing crops for a few days at a time when conditions were unfavorable and in a few cases the hogs were allowed to graze only a few hours per day. Grazing practices varied widely on the 3 farms having temporary summer pasture.

In addition to the grazing obtained, 4 producers harvested hay from improved permanent pastures and 3 producers harvested seed or hay from temporary winter pastures. Hay harvested from improved permanent pasture averaged .12 ton per acre for the total acreage of improved permanent pastures (Appendix Table 23). An average of 15.5 bushels of oats, 6.1 pounds of crimson clover seed, and .02 ton of hay was harvested per acre for the total acreage of temporary winter pasture. In all, .45 ton of hay, 55 bushels of oats, and 22 pounds of crimson clover seed were harvested per farm from the 3.11 acres of improved permanent pasture and 3.54 acres of temporary winter pasture used by the hog enterprise.

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[6] See Appendix Table 18 for rates per acre here applied.

Water for the hog enterprise was supplied by ponds, creeks, wells, and springs (Appendix Table 25). Ponds were used on 43 percent of the farms, creeks on 28 percent, wells on 28 percent, and springs on 18 percent. Eight of the 46 farms had two sources of water.

Breeding Practices: Only 25 of the 46 producers kept boars. However, 87 percent of these boars were purebred and two-thirds were registered. Duroc and Poland China boars were predominant, each constituting 41 percent of the total. About half of the sows were purebred; however, only a few were registered. Most of the sows (79 percent) were classified as Duroc, Poland China, or Duroc-Poland China crosses. There was one boar for each 5 sows on the farms that kept boars. There was an average of 2.5 sows per farm on those farms not keeping boars.

Spring and fall farrowings were of about equal importance, with some pigs being farrowed each month in the year. Thirty-five percent of the pigs were farrowed in February, March, and April, and 37 percent in August, September, and October (Appendix Table 12). On the average two litters of 6.5 pigs per litter were farrowed per sow; five pigs were saved per litter.

Buying and Selling Hogs: The production of pork for a particular year includes pigs raised and sold, pigs raised and kept for replacement, weight put on animals purchased and weight put on animals on hand at the beginning of the year. Therefore, sales, changes in inventory, purchases, and the amount slaughtered for home use must be taken into consideration in determining the amount of pork produced during the year studied. The production of pork averaged 9,555 pounds liveweight per farm,
2,222 per sow (Appendix Table 16).

In terms of liveweight, 94 percent
the pork produced during the year st
died was sold. Hogs other than sow
boars and pigs accounted for 94 perce
of that part which was sold (Append
Table 15). Hogs other than sows, boa
and pigs were sold at an average weig
of 205 pounds. Some hogs were so
each month in the year; however, th
periods of greatest concentration we
March-May and September-Novembe
Forty percent of the hogs, other tha
sows, boars, and pigs, were sold in Marc
April, and May; an additional 30 pe
cent was sold in September, October, an
November (Appendix Table 12). Th
sale of sows was concentrated in Apr
and May and in November and Decem
ber. Most of the boars were sold in O
tober, November, and December. Mo
pigs were sold in the spring than in th
fall.

The average price received per 10
pounds of pork sold was $18.07, whic
was 10 percent higher than the averag
price received by all producers in Missi
sippi (Appendix Tables 15 and 28). Sel
ing animals of higher than average qua
ity (breeding and weight) was probab
the major factor accounting for the hig
er price received on the farms studie
although the time and place of sale ma
have had some effect.

During the year studied, sows purcha
ed amounted to about 10 percent an
boars purchased to about 40 percent
the number on hand at the beginning
the year. Although purchases of sow
and boars were scattered throughout th
year, about 70 percent were made fro
August through December. During th
year studied, 18 pigs and feeder hog
were purchased for every 100 pigs bor
Purchases of pigs and feeder hogs we
concentrated in the late summer and ea
ly fall.

Health Practices: Hogs were vaccina

d for cholera on 46 percent of the farms, reated for internal parasites on 78 per- ent of the farms, sprayed to control ex- ernal parasites on 17 percent of the arms, and greased with burnt oil to ontrol external parasites on 20 percent f the farms.

Death losses for sows averaged about percent of the number on hand at the eginning of the year. Death losses for igs amounted to 22.5 percent of the umber born and purchased. Death los- es for hogs, other than sows, boars and igs, amounted to 1.4 percent of the umber produced.

Of the total number of pigs dying, ows killed 49 percent, other animals 24 ercent, freezing, starving and drowning, 4 percent, parasites and disease, 1 per- ent and unknown causes 14 percent Appendix Table 14). Of the total num- er of hogs (other than sows, boars and igs) dying, sows killed 4 percent, other nimals 20 percent, parasites and disease 48 percent and unknown causes 28 percent. Perhaps parasites and diseases were responsible for some of the deaths the cause of which was listed as unknown.

Labor Utilization: Labor used for the hog enterprise averaged 399 hours per farm, 93 hours per sow, and 4.2 hours per 100 pounds of pork produced. In general there was a close correlation between the size of the hog enterprise and the number of hours utilized per sow. Twenty-three farms averaging 2.4 sows required 138 hours of labor per sow compared to 76 hours of labor per sow for 23 farms averaging 6.3 sows.

Investment, Cost and Returns

Investment: Investment in the hog enterprise includes investment in the breeding herd, pasture land (including fences) and buildings. Investment in these three items averaged $914 per farm, $212 per sow, and $9.56 per 100 pounds of pork produced (Table 1).

The investment in breeding animals

Table 1. **Investment in the hog enterprise, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.**

tem	Per farm	Per sow	Per 100 pounds of pork produced
		Dollars	
Breeding herd:			
Sows	282	66	2.95
Boars	25	6	.26
Total	307	72	3.21
Pasture land:[1]			
Improved permanent	199	46	2.08
Unimproved permanent	64	15	.67
Woodland	23	5	.24
Temporary winter	135	31	1.41
Temporary summer	3	1	.03
Total	424	98	4.43
Buildings:[2]			
General barn	96	22	1.01
General hay barn	17	4	.18
Cribs and other grain storage	44	10	.46
Central farrowing house	16	4	.17
Other	10	2	.10
Total	183	42	1.92
Total investment	914	212	9.56

[1] Includes the investment in fences.

[2] One-half of the replacement cost of that portion of building used by or for the hog enterprise.

amounted to $307 per farm, or 34 percent of the total investment in the hog enterprise. Investment in breeding animals averaged $72 per sow, of which $66 was the value of the sow; the remaining $6 was the sow's share of the investment in boars.

Almost one-half of the total investment in the hog enterprise was in pasture land. This amounted to $424 per farm and $98 per sow. Improved permanent pasture and temporary winter pasture accounted for over three-fourths of the investment in pasture land.

Buildings used by the hog enterprise accounted for 20 percent of the total investment in the enterprise. The investment in buildings averaged $183 per farm and $42 per sow. The portion of the general barn used by or for the hog enterprise accounted for more than one-half of the investment in buildings.

Costs: Costs of the hog enterprise as calculated in this study include charges for feed, pasture, buildings, marketing and miscellaneous items. A charge for interest on investment was not included as a part of the cost of pastures and buildings. The cost of the hog enterprise averaged $1,386 per farm, $322 per sow and $14.50 per 100 pounds of pork produced (Table 2).

The cost of purchased feed, plus the farm value of home-grown feed, accounted for four-fifths of the cost of the hog enterprise. Feed cost averaged $1,103 per farm, $256 per sow and $11.54 per 100 pounds of pork produced. The value of corn fed constituted approximatel three-fourths of the total cost of feed.

The annual cost of pastures used b hogs amounted to $103 per farm, $2 per sow and $1.08 per 100 pounds o pork produced. This was 7.4 percen of the cost of the enterprise. Temporar winter pasture accounted for 68 percen of total pasture cost; improved permanent pasture accounted for another 2 percent.

The annual cost of pastures used b hogs averaged $32 per farm, $7 per sow and $0.33 per 100 pounds of pork produced. This was 2.3 percent of total cost.

The cost of marketing hogs, including such items as commission fees, hauling etc., amounted to $79 per farm, $18 per sow and $0.83 per 100 pounds of pork produced. This amounted to 5.7 percent of the cost of the enterprise.

Miscellaneous cost items such as veterinary fees and medicine, taxes, breeding fees, feed grinding, minerals, salt, etc., amounted to $69 per farm, $16 per sow and $0.72 per 100 pounds of pork produced. These cost items accounted for 5 percent of the total.

Returns: Total returns averaged $1,805 per farm, $420 per sow and $18.99 per 100 pounds of pork produced. The value of animals produced accounted for 97 percent of total returns, and pasture credits for 3 percent (Table 3).

The difference between total returns and cost, as calculated in this study, represents the return to the operator (1) for

Table 2. Costs of the hog enterprise, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Per farm	Per sow	Per 100 pounds of pork produced
		Dollars	
Feed	1,102.76	256.46	11.54
Pasture	103.17	23.99	1.08
Building	31.78	7.39	.33
Marketing	79.48	18.48	.83
Miscellaneous	68.67	15.97	.72
Total	1,385.86	322.29	14.50

capital invested in the enterprise, (2) for labor used in taking care of the enterprise and (3) for management of the enterprise. Returns to investment labor and management averaged $419 per farm; $97 per sow and $4.39 per 100 pounds of pork produced. When interest on investment in the enterprise is deducted, the balance represents the return to the operator for labor used in taking care of the enterprise and for management of the enterprise. Returns to labor and management averaged $373 per farm, $87 per sow, $3.91 per 100 pounds of pork produced, and $0.94 per hour of labor used.

The relatively high returns to investment, labor and management was due in part to the favorable corn-hog ratio that existed in Mississippi during the year studied. At that time the corn-hog ratio for Mississippi was 14.16, as compared to 12.42, for the five-year period beginning July 1947 and ending June 1952 (Appendix Table 28). If corn had been priced at its normal or average level in relation to the price of pork in Mississippi, cost would have been increased $118 per farm, $28 per sow and $1.24 per 100 pounds of pork produced; returns to investment, labor and management would have been reduced to $300 per farm, $70 per sow and $3.15 per 100 pounds of pork produced; and returns to labor and management would have been reduced to $255 per farm, $59 per sow, $2.67 per 100 pounds of pork produced and $0.64 per hour of labor used.

Conclusions

On the farms studied, the hog enterprise appears to have been managed with some efficiency as evidenced by the favorable return to labor, investment, and management. Apparently, the quality of animals produced on these farms was above the average for the state as a whole. This should not be taken to mean that further increases in the quality of animals produced on these farms would not be desirable. Further improvements in the breeding herd and/or in the condition of animals sold would be profitable on most of these farms.

The feed required to produce 100 pounds of pork was not unduly high. However, it could have been reduced further through the use of more protein supplement on most farms and a better grazing program on some farms. Death losses were relatively high and could have been reduced by giving animals more care during the farrowing season and by the use of better health and sanitation practices.

Farrowing of pigs and the sale of hogs were scattered throughout the year. From the standpoint of efficiency and produc-

Table 3. Returns to the hog enterprise, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Per farm	Per sow	Per 100 pounds of pork produced
		Dollars	
Value of pork produced	1,743.43	405.45	18.25
Pasture credits	61.29	14.25	.64
Total return	1,804.72	419.60	18.89
Less costs	1,385.86	322.29	14.50
Returns to investment, labor and management	418.86	97.31	4.39
Less interest on investment	45.70	10.60	.48
Returns to labor and management	373.16	86.71	3.91
Returns to labor and management per hour of labor used	.94	.94	.94

tion and marketing a greater concentration of farrowing and of sales in the spring and in the fall would be desirable.

Results of this study and of experiments conducted by the Animal Husbandry Department indicate that pork production in this area could be made more profitable by better management in several phases of the hog enterprise. The following recommendations are made for increasing net returns from pork production in this area:

(1) Improve the quality of animals produced by using purebred boars, selecting with more care replacement gilts and marketing hogs at about 225 pounds in weight, when there is a normal relationship between the price of corn and hogs.

(2) Reduce feed required to produce 100 pounds of pork by feeding protein supplement equivalent to 15 percent of the total ration and by maximum utilization of forage.

(3) Reduce death losses and maintain animals in a healthy condition by taking better care of animals during the farrowing season and by utilizing good health and sanitation practices such as rotation of grazing plots, vaccinating for cholera and treating for internal and external parasites.

(4) Increase efficiency of handling and of production by breeding for spring litters to be farrowed in March or April and fall litters in September or October, and

(5) Increase marketing efficiency by marketing spring litters in October or November and fall litters in April or May when there is a normal seasonal movement in prices received for hogs.

Appendix I

Methods Used in Calculating Investment, Costs, and Returns

A. Investment.

1. **Breeding Stock:** The average number of each class of hogs was calculated from the number on hand at the beginning and at the end of the year. Investment in the breeding stock was determined from the average number of each class of animals and producer estimates of the value of each class at the end of the year. An allowance was made on each farm for changes in weight of each class of animal.

2. **Land:** Acreage of pasture land used by hogs was calculated by prorating the total acreage, on the basis of grazing secured between hogs and other livestock. Investment in pasture land was based on the number of acres used by hogs and producer estimates of value per acre which included the value of fences. Only one-half of the value of land double-cropped was included in the investment. Woodland pasture was valued for grazing purposes only.

3. **Buildings:** It was assumed that the average investment in buildings would approximate one-half of the replacement cost. Investment in buildings was based on this assumption and on producer estimates of replacement cost. Investment in buildings used jointly with other livestock was prorated on the basis of the proportion used for the hog enterprise.

B. Costs.

1. **Feed:** Feed cost was based on producer estimates of quantities fed and the average price of each kind of feed. The price used for home-grown feeds was the price paid farmers during the harvest season.

2. **Pasture:** Pasture cost was based on the acreage used by the hog enterprise and the annual cost per acre of pasture. In calculating pasture costs, la-

bor cost was calculated at the prevailing wage rate of 40 cents per hour; machinery cost was based on farm management cost studies; fencing cost was based on producer estimates as to the materials, labor, and equipment used and prevailing prices; and seed and fertilizer costs were calculated by using average prices for the year studied and producer information as to the quantities used.

In calculating the total cost of improved permanent pasture, the total cost of improvements made was calculated on the basis of July 1949-June 1950 prices regardless of the year in which the improvement was made. Because of wide differences in P.M.A. payment rates in different years and the different counties, no deduction from total pasture cost was made for these payments.

Upon the recommendations of agronomists the annual charges for seed, fertilizer, and land preparation for improved permanent pasture were calculated as follows: (1) seed, one-tenth of the total cost; (2) land preparation except applying fertilizer, one-tenth of the total cost; and (3) cost of fertilizer and its application was calculated as follows: the total cost of nitrogen was charged to the year applied; 40 percent of the total cost of phosphate, potash and basic slag was charged to the year applied, 40 percent to the following year and 20 percent to the third year; and 20 percent of the total cost of lime was charged to each of the first four years after its application, 10 percent to the fifth year and 10 percent to the sixth year. In addition, the annual cost of improved permanent pasture included mowing and fencing.

3. **Buildings:** Building cost included depreciation and repairs. The annual charge for depreciation was calculated by the straight-line method, charges for repairs were based on farm management cost studies and were calculated at 3 percent of replacement cost.

4. **Labor:** Labor cost was based on producer estimates of time spent on the hog enterprise and the prevailing wage rate (40 cents per hour).

5. **Marketing:** Marketing cost was based on producer information as to commission fees and other marketing cost.

6. **Miscellaneous:** Miscellaneous cost was based on producer information as to these costs or as to the quantitiees of miscellaneous items used and the average price of these items.

C. **Receipts.**

1. **Pork Production:** Receipts from the production of pork were calculated by adding the value of animals sold, animals killed for food and inventory changes and subtracting the value of animals purchased. In calculating the value of inventory changes, increases or decreases in inventory were valued at prices per pound prevailing at the end of the year.

2. **Pasture Credits:** Pasture credits were based on producer estimates as to the quality of hay and seeds harvested from pasture land charged to the hog enterprise and prevailing prices for these items. The average price received for these items was discounted by an amount equal to the cost of harvesting.

Appendix II

Statistical Tables

Appendix table 1. Land use, 46 farms having hog enterprises, Shortleaf Pine Area, July 1949-June, 1950.

Item	Acres per farm	Percent of acres operated
Owned	261	93.2
Rented in	21	7.5
Rented out	2	.7
Operated	280	100.0
Cropland	95	33.9
Permanent pasture	50	17.8
Woodland pasture	64	22.9
Woodland	64	22.9
Farmstead and other	7	2.5

Appendix table 2. Cropland utilization, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Acres per farm	Percent of total
Cotton[1]	16	16.8
Corn[2]	45	47.4
Oats	5	5.3
Hay	21	22.1
Temporary winter pasture	8	8.4
Temp. summer pasture	3	3.2
Other crops	2	2.1
Idle cropland	6	6.3
Land double-cropped	11	11.6
Total	95	100.0

[1] Nine acres or 56 percent of the cotton was worked by croppers.

[2] Fourteen acres or 31 percent of the corn was worked by croppers.

Appendix table 3. Other livestock enterprise of commercial importance, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Enterprise	Number of farms having	Percent of farms having	Average number of specified animals per farm having
Dairy[1]	5	11	14
Beef[2]	19	41	19
Poultry, eggs[3]	1	2	300
Poultry, broilers[4]	1	2	6,600
Farms having at least one other enterprise[5]	22	48	--------

[1] Farms having 10 or more cows. The number of milk cows for all farms averaged 4.1.

[2] Farms selling 10 or more beef animals. The number of beef animals sold for all farms averaged 10.3.

[3] Farms having over 200 hens. Five other farms had from 100 to 150 hens.

[4] Farms selling over 1,000 broilers. No other farm sold as many as 100 broilers.

[5] Of commercial importance in addition to hogs.

Appendix table 4. Age and sex distribution of family labor force, 46 farms having hog enterprise. Shortleaf Pine Area, July 1949-June 1950.[1]

Age group	Males	Females	Total
	No. per farm		
Under 9	.35	.30	.65
9-12	.35	.24	.59
13-17	.33	.33	.66
18-59	1.02	1.02	2.04
60-69	.11	.11	.22
70 and above		.07	.07
Total	2.16	2.07	4.23

[1] In addition 72 days of wage labor was hired per farm of which about one-third was hired by the month.

Appendix table 5. Age of operators, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Age group	Number of operators	Percent of operators
20-29	4	8.7
30-39	16	34.8
40-49	13	28.2
50-59	8	17.4
60-69	5	10.9
Total	46	100.0

Appendix table 6. Hours of labor used for the hog enterprise per farm, per sow, and per hundredweight of pork produced, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Month	Hours of labor used for the hog enterprise		
	Per farm	Per sow	Per 100 lbs. of pork
January	33	7.8	.35
February	31	7.2	.32
March	34	8.0	.36
April	33	7.7	.35
May	33	7.8	.35
June	32	7.4	.33
July	33	7.7	.35
August	34	7.9	.36
September	34	8.0	.36
October	35	8.1	.36
November	34	8.0	.36
December	33	7.8	.35
Total	399	93.4	4.20

Appendix table 7. Labor cost for the hog enterprise per farm, per sow, and per 100 pounds of pork produced, 46 farms having hog enterrise, Shortleaf Pine Area, July 1949-June 1950.

Item	Hours	Cost
		Dollars
Labor per farm	399.0	$159.60
Labor per sow	92.8	37.12
Labor per 100 pounds of pork produced	4.2	1.67

Appendix table 8. Power and equipment used 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Number of farms having	Percent of farms having
Workstock[1]	43	93
Tractor[1]	33	72
Disk	40	87
Breaking plow	40	87
Cultipacker	5	11
Grain drill	6	13
Lime spreader	21	46
Mower	39	85
Rake	34	74
Baler	12	26
Combine	5	11
Silage cutter	2	4
Corn picker	1	2

[1] Thirty farmers had tractors and mules, 13 had mules only and 3 had tractors only.

Appendix table 9. Buildings used in connection with the hog enterprise, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Type of buildings	No. of farms having	Percent of farms having	Replacement cost per building	Replacement cost per farm	Replacement cost to hogs
			Dollars	Dollars	Dollars
General barn	33	72	1,303	935	191
General hog barn	9	20	214	42	34
Crib or grain storage	12	26	412	108	87
Central farrowing house	5	11	288	31	31
Individual farrowing house	11	24	34	8	8
Other	4	9	156	14	12
Total	46	100	-------	1,138	363

Appendix table 10. Building cost for the hog enterprise per farm, per sow, and per 100 pounds of pork produced, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Building cost for the hog enterprise		
	Per farm	Per sow	Per 100 lbs. of pork
		Dollars	
Depreciation	20.89	4.86	.22
Repairs	10.89	2.53	.11
Total	31.78	7.39	.33

Appendix table 11. Hog numbers per farm, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	On hand on July 1, 1949	Born	Purchased	Home use	Sold	Died	On hand on June 30, 1950	Avg. of inventories[1]
Sows	4.0	------	.4	----	1.0	.2	4.6	4.3
Boars	.5	------	.2	----	.2	------	.6	.6
Pigs (under 50 lbs.)	15.0	55.9	2.6		3.5	13.2	13.8	14.4
Other hogs	10.5	------	7.5	3.1	41.2	.6	14.7	12.6
Total	30.0	55.9	10.7	3.1	45.9	14.0	33.7	31.9

[1] July 1, 1949 and June 30, 1950.

Appendix table 12. Percentage of pigs born, pigs purchased, feeder hogs purchased, pigs sold and hogs sold, by months, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Month	Pigs born	Pigs purchased[1]	Feeder hogs purchased	Pigs sold[2]	Hogs sold[3]
			Percent of total		
January	3.3	.8	--------	--------	6.0
February	12.4	--------	--------	5.1	6.0
March	12.8	--------	2.8	8.6	16.9
April	10.0	--------	--------	43.9	9.4
May	3.3	--------	1.4	12.2	14.0
June	4.3	.8	11.7	--------	6.5
July	4.3	13.3	--------	--------	4.1
August	9.5	64.2	46.7	--------	3.2
September	19.8	20.9	7.0	12.2	13.2
October	7.8	--------	24.3	16.6	8.3
November	6.3	--------	6.1	--------	8.0
December	6.1	--------	--------	1.4	4.4
Total	100.0	100.0	100.0	100.0	100.0

[1] Purchases of sows and boars were scattered throughout the year; however, about 70 percent of the total number was purchased from August through December

[2] The sale of sows was concentrated in April and May and in November and December, about one-third of the total was sold in each 2-month period. Eight of the ten boars were sold in October, November, and December.

[3] Other than sows, boars, and pigs.

Appendix table 13. Health practices, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Number of farms	Percent of farms
Vaccinating for cholera	21	46
Treating for internal parasites	36	78
Spraying for external parasites	8[1]	17
Greasing with burnt oil for external parasites	9	20

[1] An average of 6 times per year.

Appendix table 14. Causes of death of animals 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Cause of death	Sows	Pigs	Slaughter hogs
		Percent of total	
Killed by sow	------	49	4
Killed by other animals	20[1]	24[3]	20
Frozen, starved and drowned	-- --	14	--
Unknown	50	11	28
Parasites and diseases	10	1	48
Other	20[2]	1[4]	------
Total	100	100	100

[1] Killed by dog and train.

[2] Farrowing.

[3] Includes some pigs reported killed by buzzards.

[4] Killed by poison weeds.

Appendix table 15. Pounds and value of pork sold per farm, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Liveweight	Value	Average price received
	Pounds	Dollars	Dollars
Sows	306	47.11	15.40
Boars	84	13.67	16.27
Pigs	122	37.50	30.74
Other hogs	8,446	1,520.77	18.01
Total	8,958	1,619.05	18.07

Appendix table 16. Pounds and value of pork produced per farm, per sow, and per 100 pounds of produced, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Liveweight per farm	Liveweight per sow	Value per farm	Value per sow
	Pounds	Pounds	Dollars	Dollars
Sales	8,958	2,083	1,619.05	376.52
Plus used in home	889	207	142.50	33.14
Plus increase in inventory	670	156	139.12	32.35
Minus purchases	962	224	157.24	36.56
Total	9,555	2,222	1,743.43	405.45
Value of pork produced per 100 pounds				18.25

Appendix table 17. Quantities and value of feed used by the hog enterprise, per farm and per 100 pounds of pork produced, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Quantity	Cost
	Pounds	Dollars
Corn, hand-fed	35,574	736.89
Corn, hogged-down	5,923	99.42
Soybeans, hand-fed	57	2.00
Soybeans, hogged-down	524	16.59
Oats	243	6.76
Cottonseed meal	369	12.91
Soybean meal	130	5.46
Tankage	490	31.12
Commercial supplement (protein)	2,447	150.49
Wheat shorts	492	17.17
Commercial mixtures	465	23.95
Total per farm	46,714	1,102.76
Total per sow	10,864	256.46
Total per 100 pounds of pork produced	489	11.54

Appendix table 18. Land preparation, fertilization, and seeding practices, improved permanent pasture grazed by hogs, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Percentage of total acreage covered	Times over or rate where performed
Land preparation:		
Disking	25	2.16
Breaking	6	1.00
Harrowing	16	1.46
Cultipacking	----	-------
Fertilizing	89	1.28
Liming	14	1.00
Seeding	23	1.54
Mowing	88	1.61
Fertilization:		
Lime	14	1,540
Basic slag	56	861
Mixed fertilizer	2	330
Nitrogen (N)	3	23
Phosphate (P_2O_5)	57	110
Potash (K_2O)	32	48
Seeding:		
Lespedeza[1]	10	21.85
White Dutch clover	15	7.31
Crimson clover	4	13.75
Dallis grass	3	14.62
Fescue	5	5.91
Black medic	----[2]	1.00

[1] Mostly common.

[2] Less than .5 percent.

Appendix table 19. Annual land preparation, fertilization, and seeding practices, temporary winter pasture grazed by hogs, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Percentage of total acreage covered	Times over or rate where performed
Land preparation:		
Disking	97	1.85
Breaking	19	1.00
Harrowing	73	1.80
Fertilizing	80	1.03
Seeding	99	1.09
Fertilization:		
Basic slag	9	500
Mixed fertilizer	1	200
Nitrogen (N)	4	32
Phosphate (P_2O_5)	74	68
Potash (K_2O)	27	50
Seeding:		
Crimson clover	10	25.89
Wild winter peas	43	23.39
Oats	89	106.66
Ryegrass	1	25.00
Vetch	36	21.30

Appedix table 20. Cost of establishment and annual cost per acre, improved permanent pasture grazed by hogs, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Cost of establishment	Annual cost
	Dollars	
Land preparation	2.11	.43
Fertilizer	8.83	2.80
Seed	2.51	.25
Breaking	---	.05
Fencing	- - -	1.33
Mowing	--	1.74
Total[1]	13.45	6.60

[1] When interest is charged at 5 percent on the investment in land and fences, the annual cost averaged $9.80 per acre.

Appendix table 21. Annual pasture cost per acre, improved permanent, woodland, temporary winter and temporary summer, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Unimproved permanent	Woodland	Temporary winter	Temporary summer
		Dollars		
Land preparation	------	------	4.60	4.22
Fertilizer	------	------	4.49	5.11
Seed	--- -	------	9.83	2.89
Fencing	3.58	1.26	.85	3.00
Mowing	------	------	--------	--------
Total[1]	3.58	1.26	19.77	15.22

[1] When interest is charged at 5 percent on the investment in land, the annual cost is as follows: **unimproved permanent, $5.67; woodland, $1.51 temporary winter, $21.67; and temporary summer,** $16.81.

Appendix table 22. Acres and cost of pasture used by the hog enterprise per farm, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Type of pasture	Acres per farm	Acres per sow	Cost per farm	Cost per sow
			Dollars	Dollars
Improved permanent	3.11	.72	20.53	4.78
Unimproved permanent	1.53	.36	5.48	1.27
Woodland	4.72	1.10	5.95	1.38
Temporary winter	3.54	.82	69.99	16.28
Temporary summer	.08	.02	1.22	.28
Total	12.98	3.02	103.17	23.99
Total cost per 100 pounds of pork produced				1.08

Appendix table 23. Pasture credit per acre and per farm for the hog enterprise, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Quantity		Value	
	Per acre	Per farm	Per acre	Per farm
Improved permanent pasture:[1]				
Hay, ton	.12	.38	1.64	5.09
Temporary winter pasture:[2]				
Oats, bushels	15.47	54.78	11.14	39.44
Crimson clover seed, pounds	6.14	21.74	4.42	15.65
Hay, ton	.02	.07	.31	1.11
Total temporary winter pasture	-------	-------	15.81	56.20
Total all pastures	-------	-------	-------	61.29
Total per sow	-------	-------	-------	14.25
Total per 100 lbs. of pork	-------	-------	-------	.64

[1] Four of the 18 farmers having improved permanent pasture harvested hay from their improved permanent pasture.

[2] Three of the 14 farmers having temporary winter pasture harvested hay or seed from their temporary winter pasture.

Appendix table 24. Replacement cost and annual cost of one mile of permanent fence[1], 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Quantity	Cost
		Dollars
Replacement cost per mile:		
Wire, woven	16 rolls	240.00
Wire, 4-point barb	8 rolls	60.00
Staples	55 pounds	6.00
Posts	660	165.00
Labor	300 hours	120.00
Hauling (tractor and trailer)	3 hours	3.00
Total		594.00
Annual cost per mile:		
Depreciation		29.70
Repairs		25.25
Total		54.95

[1] Erected in the usual manner.

Appendix table 25. Sources of water for the hog enterprise, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Source	Number of farms	Percent of farms
Pond only	13	28
Creek only	11	24
Well only[1]	10	22
Spring only	4	9
Pond and creek	1	2
Pond and well	2	4
Pond and spring	4	9
Creek and well	1	2
Total	46	100

[1] Of this group, 4 had running water.

Appendix table 26. Cost of marketing hogs, 46 farms having hog enterprise, Shortleaf Pine Area, July 1949-June 1950.

Item	Cost per farm	Percent of total
	Dollars	
Commission fees	45.72	57.5
Hauling	32.00	40.3
Yardage, insurance and weighing	1.76	2.2
Total	79.48	100.0
Total per sow	18.48	
Total per 100 pounds of pork produced	.83	

Appendix table 27. Miscellaneous costs of the hog enterprise, 46 farms, Shortleaf Pine Area, July 1949-June 1950.

Item	Cost per farm	Cost per sow	Percent of total
	Dollars	Dollars	Dollars
Veterinary fees and medicine	17.78	4.14	25.9
Spray material and disinfectant	1.43	.33	2.1
Taxes	12.67	2.95	18.4
Breeding fees	6.11	1.42	8.9
Feed grinding	4.72	1.10	6.9
Salt	3.70	.86	5.4
Minerals	3.78	.88	5.5
Hauling purchased feed	3.59	.83	5.2
Auto expense	7.91	1.84	11.5
Fencing cost for corn and soybeans hogged down	5.22	1.21	7.6
Other[1]	1.76	.41	2.6
Total	68.67	15.97	100.0
Total cost per 100 pounds of pork produced		.72	

[1] Includes insurance on buildings, electricity and telphone.

Appendix table 28. The corn-hog ratio for Mississippi for the year studied compared with the average corn-hog ratio for Mississippi for the 5-year period beginning July 1947 and ending June 1952.

Period	Average price received for pork[1]	Average price received for corn[2]	Corn-hog ratio
		Dollars	
July 1947-June 1952	19.25	1.55	12.42
July 1949-June 1950	16.42	1.16[3]	14.16

Source: Monthly issue of **Agricultural Prices**, BAE, USDA.

[1] Simple average of monthly prices.

[2] During the harvesting season (October, November, and December).

[3] If a normal relationship had existed between the price of pork at \$16.42 and the price of corn, the price of corn would have been \$1.32 per bushel (\$16.42 divided by 12.42 = \$1.32).

BULLETIN 501 JUNE 1953

Control of Prairie Crawfish

A pasture heavily infested with crawfish.

AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
MISSISSIPPI STATE COLLEGE
STATE COLLEGE MISSISSIPPI

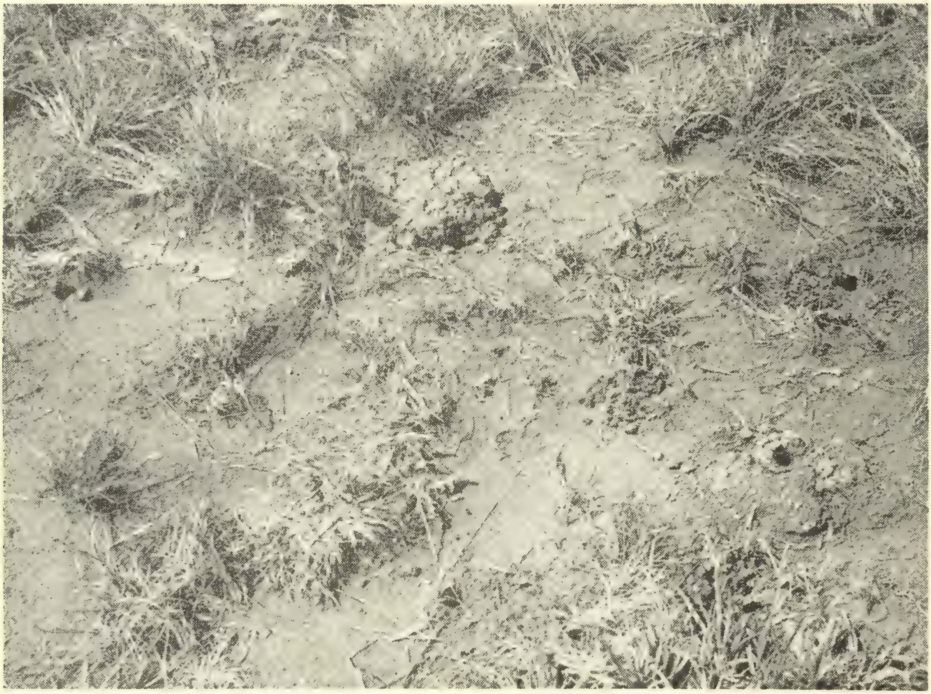

Figure 1. Close-up view in a very heavily infested pasture.

CONTROL OF PRAIRIE CRAWFISH

By A. L. HAMNER

Area Infested

The prairie crawfish, (**Cambarus hagenianus,** Faxon) and its sub-species (Lyle 1937), occur in the northeast and central prairie of Mississippi. **C. hagenianus** also occurs in Alabama but its distribution and that of its sub-species are not known. The area most heavily infested in Mississippi is in Chickasaw, Monroe, Clay, Oktibbeha, Lowndes and Noxubee counties of the Northeast Prairie. The sub-species occuring in the Central Prairie is of very little economic importance.

The heavily infested land is of a heavy type soil with poor internal drainage. That most heavily infested is of a seepy nature which could not be classed as highly desirable for row crops. Small areas of a hundred square feet and up to an acre or two in rare cases may be almost completely bare of vegetation. These areas are heavily infested and the absence of vegetation is often attributed to "crawfish damage." The lack of desirable vegetation is due not only to the crawfish infestation but also to the presence of poor conditions for plant growth.

All of the land in the area is not infested. The infestation within an individual field may vary from practically none to a very heavy one, depending on the physical structure of the soil. The conditions most suitable appear to be lands which have a high water holding capacity and poor internal drainage and at the same time have excellent surface drainage

Food.

The principle food of this crawfish appears to be vegetable matter, either alive or dead. Blades of grass are cut off as if by a pair of scissors (fig. 1), if the growth is tender. On older growth the leaves are ragged. Cotton plants just after they emerge are cut off just above the surface of the soil. The pest often gathers plant material and leaves a portion of it near the burrow entrance or, if the burrow is closed by the construction of a mud plug, parts of leaves and other debris may be found mixed with the mud.

Apparently the amount of food required is very small as individuals can live for long periods without any food under laboratory conditions.

Burrow Habits.

Excavations show that the burrows are almost vertical for the major portion of their course. A few burrows have been followed which were 10 to 12 feet in length. At the lower end of most burrows a small cavity is usually found which will hold about a quart of water. This cavity is called the crawfish's "silo" by some people in the infested area. Whether its primary purpose is for the storage of food is not known but it probably has some relation to the water requirements of the animal.

Within about 2 feet of the surface, branches off the main burrow often occur. In some instances an individual burrow may have as many as three or four openings. On cultivated land two openings with as little as a small bridge of soil an inch in diameter between them are not uncommon.

The heaviest infested land may have as many as 20,000 burrows per acre, but the usual infestation will be 8,000 to 15,000 per acre. It is very probable that the number of burrows that show evidence of recent crawfish activity is greater than the actual number of adult crawfish present. Such burrows during the spring months have a smooth, almost round opening, a slick appearance of the wall of the hole, and usually a small pile of mud adjoining the hole or nearby. However, under some conditions no mound is present. The opening of the burrow may be sealed. In some cases its presence may be indicated by only a small elevation of the soil and the collection of debris on it.

Number of Crawfish in a Burrow.

In the 100 or more burrows which were examined in detail by Lyle (1937) only one crawfish was found established to a burrow. That of course excludes the young in a burrow with a female. There is a possibility that two individuals may occupy a burrow while mating, but this is a pure conjecture since mating has not been observed in this species. Some other species are known to mate in the burrows.

Surface Activity.

Activity on the surface is very largely governed by rainfall. The largest numbers leave their burrows and crawl about on the soil surface on warm rainy nights and on nights following heavy rainfall when the water table is high. Surface activity on other nights is quite variable. As a general rule limited activity may be expected except when the water table is high or when it is raining. The frequency at which individual crawfish may come to the surface is not known but there is evidence which indicates that some individuals may remain in their burrows for long periods.

The most active period on an average appears to be during March and April. Most planters are of the opinion that crawfish damage decreases to such an extent by May that any crop planted at that time will not be seriously damaged. Suitable conditions have not been available to determine the activity during the dryer months. During these months the vegetative growth is such that the crawfish cannot be seen by the usual methods. However, destruction of the grass on small areas around the openings of the burrows makes it evident that restricted surface activity occurs at intervals during these dry months later in the season.

Damage.

As indicated previously, the native habitat of the prairie crawfish is the rolling lands used either for pasture or hay production. Under such conditions one of the principle objections is that the mounds "gum up" hay mower blades. Heavy infestations may cause a serious reduction in the amount of forage produced. Generally speaking 5000 to 6000 burrows per acre do not appear to be of very great economic importance. It is when efforts are made to improve pasture and hay lands that the lighter infestations are considered important.

When land use is changed from hay to row crops the damage usually assumes serious proportions. A partial or complete loss of stands from early planting is not uncommon in such cases.

CONTROL

Some of the earlier experiments, Lobdell (1912), consisted of testing a number of chemicals, tile drainage and dynamiting. Carbon disulphide (high life) was recommended. Later Lyle (1937) developed the use of coal tar creosote emulsion, the concentrate equivalent of which could be bought in the form of a stock dip. The latter control measure was by far the most satisfactory one that had been developed, especially from the standpoint of cost of materials. Its chief fault was that it was necessary to treat the burrows individually which made labor requirements excessive. Where only a few burrows are involved it is still probably as satisfactory as any control measure known.

With the advent of DDT it was found that this new material held promise for the control of pest crawfish.

Insecticides Tested.

Several of the newer organic insecticides were tested under both laboratory and field conditions. All of them have killed crawfish. However, from an overall consideration none has appeared to be superior to DDT. For that reason, the urgency for a more satisfactory control measure and the shortness of the period during which work on control measures could be done DDT was used in the major portion of the tests.

"Bait" has been generally accepted as a term to designate the application of DDT by means of mixing it with some material such as cotton seed, cottonseed hulls or coarsely ground corn cobs. They may to some extent actually serve as a bait but such is not essential for the insecticide to be effective.

No consistent differences were found among the three materials as carrying agents for DDT. Sawdust was not sufficiently tested to determine whether it would be satisfactory. The many kinds of sawdust and its degree of decomposition would make recommendations for its use very difficult. At the present time several insecticides are being formulated as granular materials. DDT formulated as a granular material has been demonstrated as having properties which will kill crawfish. However, its effectiveness in comparison with other formulations has not been tested.

A bait that has proven satisfactory may be made as follows. This amount is sufficient for one acre.

1½ bushels by volume of cottonseed hulls, cottonseed or coarsely ground corn cobs.

4 pounds of 50% DDT wettable powder.

1½ gallons water.

The DDT wettable powder is first mixed with the water. The DDT settles out rapidly so the mixture should be stirred often. While constantly stirring the carrying agent slowly pour the DDT water mixture on it. This is necessary in order to get a uniform distribution.

Baits may be applied broadcast or in bands 36 to 42 inches apart. Both methods of application have proven to be effective.

A DDT emulsifiable concentrate may be used instead of the wettable powder. In some tests the same amount of DDT from an emulsifiable concentrate has been more effective than from wettable powder. The exact relative effectiveness of the two has not been established. Because of the somewhat greater hazard encountered in the hand distribution of emulsion treated carrying agents, wettable powders are considered as being safer to handle where baits are likely to be used.

Although baits were previously accepted as the best means of control that had been developed they were not becoming popular because of the difficulty in mixing and distributing them. Sprays were tried using the litter on the ground as the carrying agent. In these tests practically all of the litter was destroyed on some plats. The results showed that the action of DDT was very largely contact since crawfish were killed on ground almost devoid of any vegetation.

Spray applications have consistently given control of 90% or better when 2 pounds of DDT per acre were applied. The spray should be made up as follows:

One gallon of 25% DDT emulsifiable concentrate is diluted with water to make enough emulsion to spray an acre. The amount of water used will be governed by the equipment with which the spray is applied.

Any type of low gallonage spray equipment may be used and airplane applications (Fig. 2) have proven satisfactory. It is very important that the insecticide be well distributed (Fig. 3) regardless of the type of equipment that is being used. Drift of spray should not be depended upon for coverage.

Determining Degree of Control.

Dead crawfish on the surface have a good psychological effect but they cannot be used as a measure of the effectiveness of an insecticide. Even if birds, etc. did

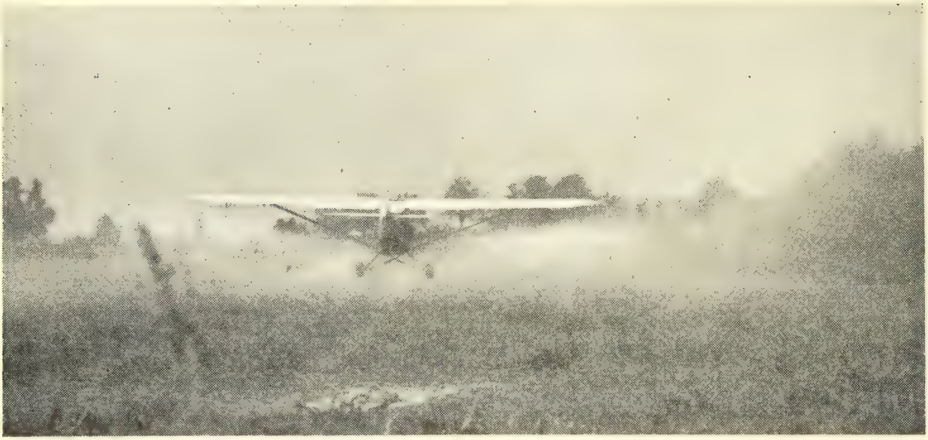

Figure 2. Airplane applying DDT spray for crawfish control

not influence the number of dead crawfish present, the mere fact that the grass and weeds would make it difficult to find them renders such evaluation of questionable value. Some of the experiments showed that control may be obtained without actually being able to find any great number of dead crawfish. The number of burrows which showed signs of having a live crawfish in them, for convenience called "active burrows," was used as a means of determining the population.

After several counts were made at intervals on the same plots it became obvious that the degree of control could not be determined the same year that the control measures were applied The principal reasons for this were the very irregular surface activity of individual crawfish, the period of effectiveness of the insecticides, the difficulty experienced in finding the burrows after a period of dry weather, and the presence of increased vegetative growth. Consequently, the effectiveness of a control measure was based on the number of active burrows found the spring of the year following treatment.

Timing Application of Control Measures.

Observations by farmers and those who have worked experimentally established the fact that the greatest surface activity occurs on rainy nights and on nights following heavy rainfall. The application of control measures under such exacting conditions, although desirable, were not considered practical for the average farm conditions, neither was it practical under the conditions in which the experiments had to be conducted.

It is generally known that the greatest seasonal surface activity occurs during the spring months, being greatest during March and April. Other than restricting the application of control measures very largely to those months no other weather conditions were considered. As a matter of fact it was necessary for the surface of the soil to be dry in order to use experimental spray equipment with which most of the applications of sprays were made. This procedure has given the experimental control measures a very severe test.

Period of Effectiveness.

The very irregular surface activity of this species of crawfish makes it necessary that the insecticide have a long residual action. Checks of dying crawfish on small treated areas showed that DDT was effective for four weeks or more. After larger treated areas became available for study observations indicated that it is effective for at least six weeks. These observations are in agreement with those of several farmers.

Control on Cultivated Land.

Control of crawfish on land that is to be converted from sod to row crops requires considerable planning if it is to be highly effective. The two most practical procedures are:

(1) Apply the control measure during the spring previous to that in which the land is to be planted to row crops, or

(2) Prepare the land during the fall and apply the control measure in the spring at least one month before any additional preparation of the soil is done for planting.

A fairly high degree of control has been obtained when baits were applied at planting time but the slow rate at which DDT kills the crawfish is such that considerable damage may be done before they are killed. The most effective protection of cotton was obtained when the control application was made well in advance of planting. A cloddy, rough surface reduces the effectiveness because the baits become less exposed.

Sufficient land has not been available to definitely establish the value of sprays on land after it has been prepared for planting. The tests that have been conducted indicate that equal amounts of DDT are more effective when used as baits than as sprays. Baits were certainly more effective than sprays when applied at planting time when the surface soil had been disturbed. Sprays applied after the winter rains had settled the soil were more effective than those applied af-

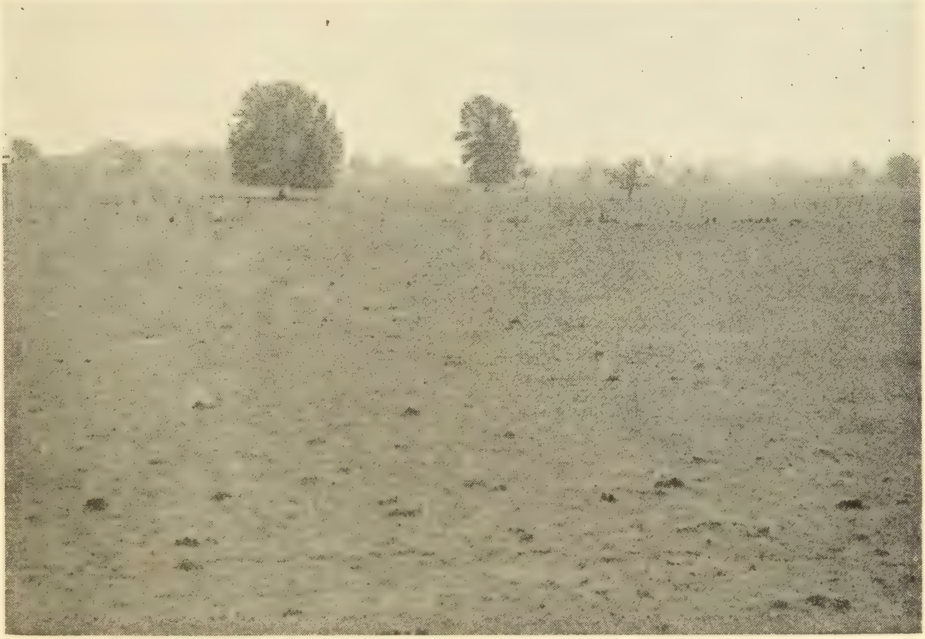

Figure 3. Active crawfish burrows in the center of this picture resulted from incomplete coverage by spray plane.

ter the surface had been disturbed. All reports indicate that sprays are not as effective on plowed land as on sod except possibly when very favorable conditions for surface activity occur immediately after the applications are made.

Control on Sod Land.

Conditions for treating sod land are not as exacting as those for cultivated land. Sprays and baits have both proven equally effective. In either case thorough distribution of the insecticide is necessary. Vegetative growth a foot or less in height did not affect control as long as it was standing erect. Where heavy plant growth is matted over the surface, baits may be expected to give better control than sprays because more of the DDT will reach the ground surface where the crawfish are active. A granulated insecticide may prove effective under these conditions.

Retreating.

Retreating with the same amount of DDT the second year has not proved practical. The most practical procedure has been to apply enough insecticide in the first application during the favorable season to effect a high degree of control. Actual eradication was not accomplished even by applying DDT at a rate of two pounds per acre for two successive seasons. Some previous work by Lyle (1937) showed that some crawfish may not come to the surface for several months.

Reinfestation.

The time required for the development of satisfactory control measures and the sizes of the areas treated have not permitted the collecting of data on the rate of reinfestation. However, the experiences of those who have farmed "crawfishy" land and observations of a few isolated cases indicate that the infestation on sod land will probably build up to a level of economic importance in about five years. Reinfestation on land kept in cultivation will occur only around the edges of the field and such infestations usually do not constitute a serious problem.

Weeds.

On hay land where crawfish are controlled the growth of weeds usually becomes a problem. This of course varies under different conditions but may be of such a nature that some alteration in management may be necessary in order to produce the maximum amount of high quality hay.

SUMMARY

The prairie crawfish infests certain upland soils in an area of Mississippi and Alabama known as the "prairie". It is primarily vegetarian in its feeding habits. Production of forage is reduced particularly during the spring months and the mounds, when wet, gum up mower blades and thus hamper mowing operations. The establishment of improved pastures is made more difficult by its presence, and where it occurs on land used for row crops it reduces the stand and may even completely destroy early plantings.

DDT is effective for its control. It may be applied either as a bait or a spray. Two pounds per acre have given satisfactory control under varied conditions. DDT is more effective on well settled than freshly plowed soil. Baits appear to be more effective on freshly plowed soil than sprays. The surface of the ground should not be disturbed for at least one month after the insecticide is applied. Thorough coverage is necessary to give satisfactory control. March and April are favorable months for the applications of the insecticide.

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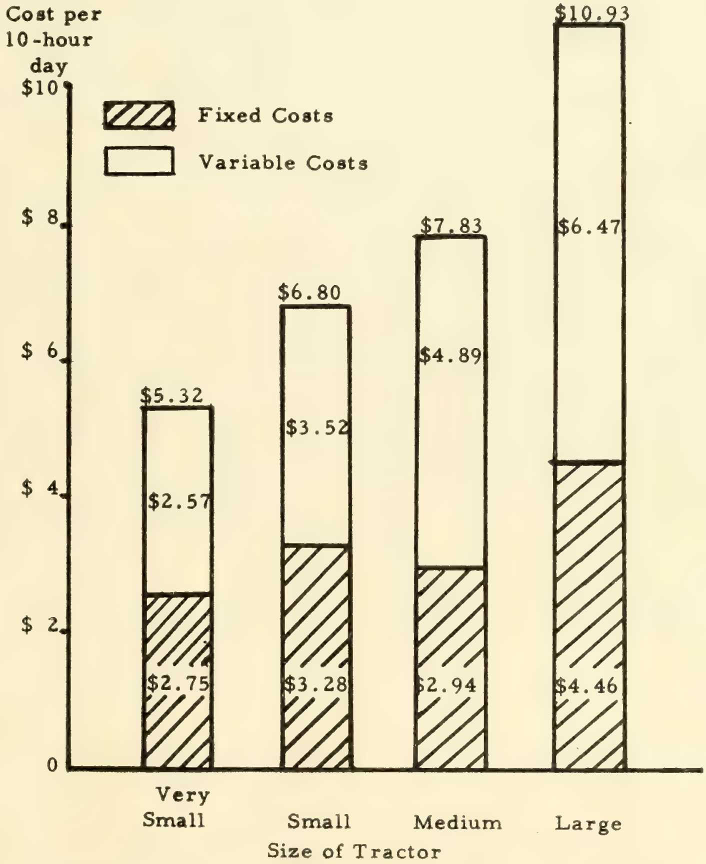
Lyle, Clay. 1937. The crawfishes of Mississippi, with special reference to the biology and control of destructive species. Unpublished Doctorial Thesis. (Iowa State College).

BULLETIN 502 JULY, 1953

Farm Mechanization

in the Upland Areas of Mississippi

1949



MISSISSIPPI STATE COLLEGE

AGRICULTURAL EXPERIMENT STATION

CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

TABLE OF CONTENTS

Title Page

INTRODUCTION 1
- The Problem 1
- Objectives of Study 2
- Location of Areas Studied 2
- Description of Areas 2
- Scope of Study 3
- Procedure 3

FARM ORGANIZATION 3
- Total Acres of Cropland Associated with Size of Tractor 4
- Organization of Tractor Farms by Number and Size of Tractor 5
  - Tenure and land-use organization 5
  - Cropland organization 6
  - Livestock organization 6
  - Kinds of machinery used 8

USE OF TRACTORS AND WORKSTOCK 11
- Heavy Work 11
  - Disc 11
  - Break 11
  - Bed 11
  - Combine with power take-off 14
- Light Work 14
  - Plant 14
  - Cultivate 14
  - Harrow 15
  - Mow 15
  - Fertilize 15
  - Combine with auxiliary motor 15
  - Belt work 15
  - Haul 16
  - Other work 16
  - Summary 16

OPERATIONS PERFORMED AND AVERAGE PERFORMANCE RATES BY SIZE OF TRACTOR 16
- Land Preparation, Planting, and Cultivation 16
- Other Operations 20

COST OF OPERATING TRACTORS, TRUCKS, TRAILERS, COMBINES, AND OTHER MAJOR FARM MACHINERY IN UPLAND AREAS, 1949 21
- Tractors 21
  - Requirements and utilization 21
  - Cost of operation 23
- Motor Trucks 25
  - Requirements and utilization 26
  - Cost of operating trucks 26
- Farm Trailers 26
- Combines 27
  - Cost of operating 27
- Hay Balers, Pick-Up 29
- Hay Balers, Stationary 29
- Corn Pickers 30
  - One-row 30
  - Two-row 30
- One-Row Binders 30

TABLE OF CONTENTS

Title — Page

Hammer Mills 30
Ensilage Cutters 30

ANNUAL USE AND COST OF OPERATING AUXILIARY TRACTOR-DRAWN EQUIPMENT 32
Land Preparation Implements 32
The moldboard plow 32
The disc harrow 32
The 3-row section harrows 32
Planting and Fertilizing Implements 37
The 1-row machine (planter and fertilizer combination) 37
The 2-row planter and fertilizer combination 37
Cultivating Implements 37
One-row cultivator attachments 37
Two-row cultivators 37

SUMMARY AND CONCLUSIONS 37
Utilization 37
Cost of Operation 38
Some Effects of Farm Mechanization 38
Trends 41
Need for Further Study of Problem 41

LIST OF TABLES

Table — Page

1. Number of farm tractors and percent of increase, by specified areas and periods 1
2. The acreage, production, and value of two major crops, and miscellaneous livestock data 4
3. Number of tractors of different sizes, by acres of cropland 5
4. Size of tractor by number of rows of usual cultivating attachments, and/or maximum drawbar horsepower rating by Nebraska tractor test 6
5. Tenure and land use organization, by number and size of tractor 7
6. Cropland organization, by number and size of tractor 7
7. Livestock organization, by number and size of tractor 8
8. Percent of farms reporting specified kinds of tractor and workstock equipment, and most common size implements on farms, by number and size of tractor 9
9. Summary of utilization of 206 tractors and workstock, by size of tractor and operations performed 12
10. Average performance rates, by operation performed and size of tractor 17
11. Annual use, fuel requirements and related information for very small, small, medium, and large tractors 22
12. Cost of operating very small, small, medium, and large tractors 24
13. Annual use, fuel requirements, and related information for trucks of different sizes on farms 25
14. Cost of operating trucks of different sizes on farms 25
15. Operating costs and related information for 79 farm trailers 27
16. Annual use, cost of operating and related information for 2'5 combines on farms 28
17. Performance and related data for hay balers, corn pickers, binders, hammer mills, and ensilage cutters 29

LIST OF TABLES—(Continued)

18. Total and per unit cost of operating hay balers, corn pickers, binders, hammer mills, and ensilage cutters 29
19. Itemized operating costs and related data for hay balers, corn pickers, binders, hammer mills, and ensilage cutters 31
20. Performance and related data for selected tractor machinery and equipment 33
21. Itemized operating costs and related data for selected tractor machinery and equipment 34
22. Total and per unit cost of operating selected tractor equipment 36
23. Number of farms, tractors, and miscellaneous information by number and size of tractor 39
24. Tractor sales of 21 implement dealers in five counties 40

LIST OF APPENDIX TABLES

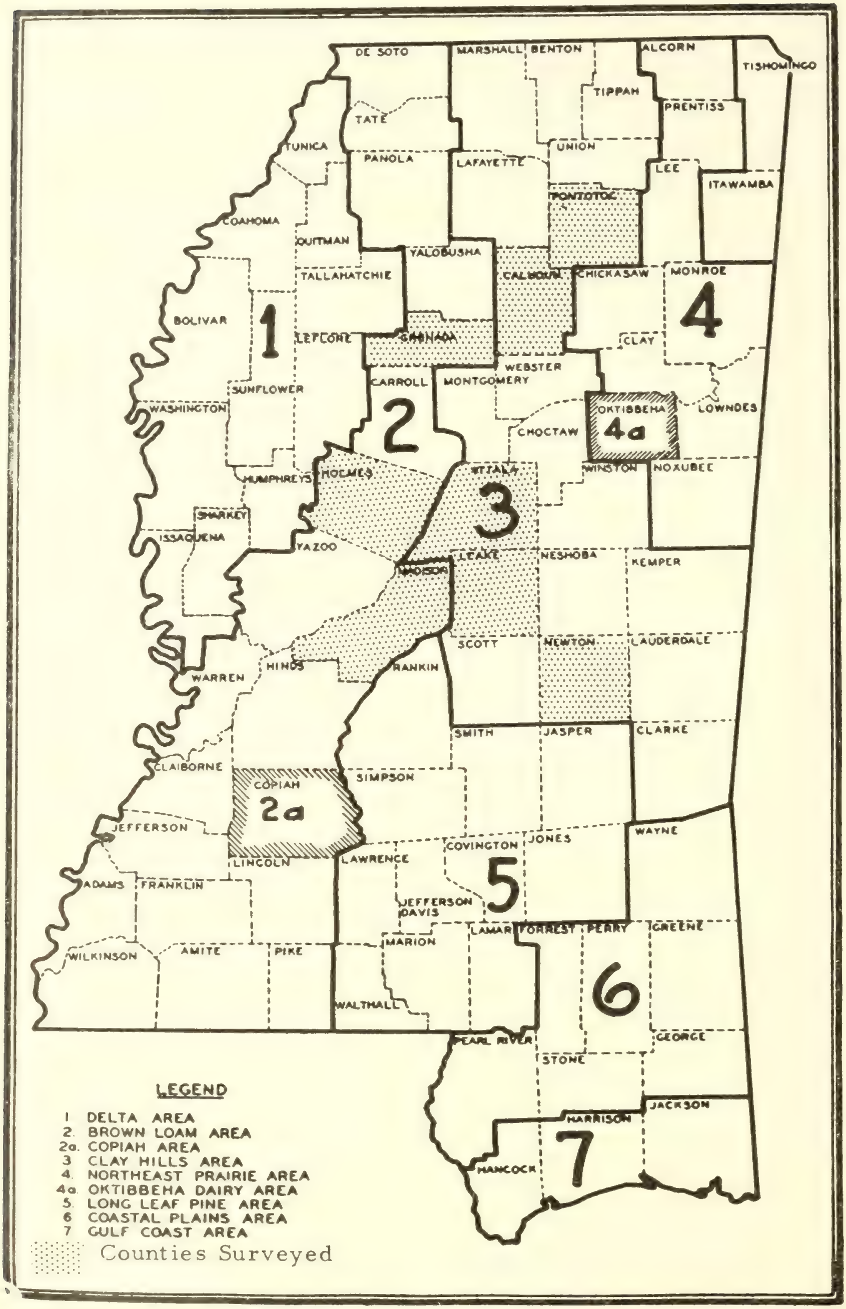
1. Tenure and land-use organization, by number and size of tractor 42
2. Cropland organization, by number and size of tractor 43
3. Livestock organization, by number and size of tractor 44
4. Summary and utilization of tractors and workstock, by size of tractor and operations performed, on 153 farms with only one tractor 45
5. Utilization of very small tractors and workstock, by operations, on 36 farms with only one tractor 47
6. Utilization of small tractors and workstock, by operations, on 37 farms with only one tractor 49
7. Utilization of medium tractors and workstock, by operations, on 78 farms with only one tractor 51
8. Utilization of large tractors and workstock, by operations, on two farms with only one tractor 53
9. Utilization of 42 very small tractors and workstock, by operations, on 41 farms 54
10. Utilization of 38 small tractors and workstock, by operations, on 38 farms 56
11. Utilization of 115 medium tractors and workstock, by operations, on 100 farms 58
12. Utilization of 11 large tractors and workstock, by operations, on 11 farms 60

LIST OF FIGURES

Figure Page

1. Type-of-farming areas in Mississippi iv

Figure 1. Type-of-Farming Areas in Mississippi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MARSHALL
BENTON
ALCORN
TISHOMINGO
TIPPAH
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PONTOTOC
COAHOMA
QUITMAN
YALOBUSHA
CALHOUN
CHICKASAW
MONROE
TALLAHATCHIE
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1
LEFLORE
GRENADA
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CARROLL
MONTGOMERY
SUNFLOWER
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OKTIBBEHA
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CHOCTAW
HUMPHREYS
HOLMES
ATTALA
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NOXUBEE
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ISSAQUENA
YAZOO
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NESHOBA
KEMPER
MADISON
SCOTT
NEWTON
LAUDERDALE
WARREN
HINDS
RANKIN
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JASPER
CLARKE
CLAIBORNE
COPIAH
2a
SIMPSON
JEFFERSON
WAYNE
LINCOLN
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JONES
ADAMS
FRANKLIN
5
JEFFERSON DAVIS
LAMAR
FORREST
PERRY
GREENE
WILKINSON
AMITE
PIKE
MARION
6
WALTHALL
PEARL RIVER
GEORGE
STONE
JACKSON
HARRISON
7
HANCOCK
LEGEND
1 DELTA AREA
2. BROWN LOAM AREA
2a. COPIAH AREA
3 CLAY HILLS AREA
4. NORTHEAST PRAIRIE AREA
4a OKTIBBEHA DAIRY AREA
5. LONG LEAF PINE AREA
6 COASTAL PLAINS AREA
7 GULF COAST AREA
▨ Counties Surveyed

FARM MECHANIZATION IN THE UPLAND AREAS OF MISSISSIPPI, 1949

By RUPERT B. JOHNSTON

INTRODUCTION

Stimulated by farm labor shortages, high farm wage rates, and high prices for farm products, mechanization of farms in the Upland areas has progressed at a rapid rate since 1940. During the last ten years the Upland areas have realized a 478 percent increase in the number of farm tractors, while the Mississippi and United States percentage increases were only 391 and 120, respectively, Table 1.

Table 1. Number of farm tractors and percent of increase, by specified areas and periods.*

Year	Area United States	 Mississippi	 Brown Loam and Clay Hills areas
		Number of Tractors	
1930	920,021	5,542	2,295
1940	1,567,405	10,577	3,331
1945	2,287,661	21,077	7,278
1950	3,442,000	51,923	19,238
		Percent increase	
1930 to '40	70	91	45
1940 to '45	46	99	118
1945 to '50	50	146	164
1940 to '50	120	391	478
1930 to '50	274	837	738

* Source: Data for Mississippi, Brown Loam, and Clay Hills areas for 1930, 1940, 1945 and 1950 were obtained from United States Census of Agriculture; data for United States for 1930, 1940, and 1945 were obtained from United States Census of Agriculture, for 1950 from "Machinery on U. S. Farms 1950", **Farm Implement News**, Vol. 71, No. 13, July 10, 1950.

The changes in Mississippi reflect trends occurring throughout the South. An article (Machinery on U. S. Farms) in the July 10, 1950 issue of **Farm Implement News** indicates the extent of such changes in the trends occurring throughout the South. A quotation from the article follows:

> Since 1945, the increase in wheel tractors in the South has been outstanding. In many southern states, there are now more than twice as many tractors as in 1945. The percentage increase in numbers of all kinds of tractor machines has in the South been much above the average of the country. Mechanization has made tremendous gains, but the degree of mechanization thus far attained in the South is below that of the rest of the country.[1]

The Problem

Upland farmers who have already largely mechanized their farms, are looking for adjustments which will enable them to use their mechanical power and equipment more efficiently. Other farmers in the hill section who realize the economic possibilities of mechanizing their farming operations, are

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(1) "Machinery on U. S. Farms 1950," **Farm Implement News**, Vol. 71 No. 13 July 10, 1950 p. 83.

moving rapidly in that direction. Still others are undecided about using tractor power and equipment on their farms, and are in need of guidance in making a decision. This study was undertaken in recognition of these problems, and the specific objectives are listed below.

Objectives of Study

The objectives of this study were: (1) to present the general farm organization where tractors are now being used on Upland farms; (2) to determine the utilization and cost of operating different sized tractors, trucks, combines, trailers, and auxiliary tractor-drawn equipment; (3) to ascertain the performance rates, by operations, of the very small, small, medium, and large tractors; and (4) to provide the general framework from which further economic analysis can be made in order (a) to determine the Upland farm setup where tractors can be used economically, and (b) to furnish a guide to farmers for selecting the most efficient sized tractor and equipment for several sizes of farms and systems of farming in the Upland areas.

Location of Areas Studied

This study was confined to the Upland areas of the state. A considerable part of Mississippi could be classified as upland, but for purposes of this study, only the Brown Loam and Clay Hills areas (See Areas 2 and 3 in Figure 1) were included. The similarity among the areas in topographic and other characteristics related to mechanization problems influenced this grouping.

The Brown Loam area (2) runs the full length of the state, on the western side. The Delta area and Mississippi River lie to its west, while the Clay Hills and Long Leaf Pine areas lie to the east in the northern and central, and southern sections, respectively. The Clay Hills area (3) runs through the central and east-central part of the state from north to south-central. It is bordered on the east by the Northeast Prairie area, and on the south by the Long Leaf Pine and Coastal Plains areas.

Description of Areas

The Brown Loam and Clay Hills areas have 38 of the state's 82 counties. According to the United States Census of Agriculture of 1945 (Multiple - Unit Operations), these two areas comprise 52 percent of total acres of farm land and 50 percent of all operating farm units of the state. In 1945, operating units in the Upland areas (2 and 3) averaged 137.9 acres, while the state average was 134.9 acres. The operating farm units in the Brown Loam area average larger than those in the Clay Hills area.

The climate of the Upland areas varies with the climate in general for the whole state. The topography varies from rough and rugged to level. The soils in the Brown Loam area are deep, light yellow to brown silty soils which are relatively high in natural fertility and highly susceptible to erosion. The Clay Hills soils vary from sandy clay to heavy clay, are relatively low in natural fertility, and are very susceptible to erosion. Climate and soils of the Upland areas vary enough to allow both specialized and general farming systems.

Scope of Study

There were 178 operating farm units covered in this study. Specific counties included in the survey are shown in Figure I. The farms studied had a total of 218,264 acres of land. Cropland represented approximately 42 percent of all land in farms. All land operated on these farms represented a little more than 2 percent of the total farm land in the Brown Loam and Clay Hills areas, and more than 1 percent of all farm land in Mississippi. The 209 tractors included in this study represented 3 percent of all tractors reported in the Brown Loam and Clay Hills areas, and 1 percent of all farm tractors reported in Mississippi, in the Agricultural Census of 1945. Only farms which had a tractor, and had used it for at least one year, were included in this study. Therefore, the general farm organization, as indicated by the census, will not be representative of such farms in the Upland areas.

Procedure

Tractor, truck, combine, farm trailer and general organization data, covering the crop year of 1948, were collected in the summer of 1949. However, during the summer of 1950 additional data on auxiliary tractor-drawn equipment were obtained from some of the same farmers. Some data were obtained from implement dealers in 1949 and in 1950. Field enumerators, using a stratified random sample, made personal interviews with cooperators, and recorded the information on a schedule.

After completion of the field enumeration, the schedules were edited for completeness and arithmetical accuracy. Then the schedules were sorted according to various factors and tabulated.

Farm organization data were collected as a part of the study, to indicate the general characteristics associated with the use of mechanical power and equipment. The general farm organization was developed according to sizes and number of tractors, and is presented in the section which follows. Farm power utilization by operations performed, analyzed in the next section, indicates the extent to which farmers were using available power.

An analysis of the time required, for the very small, small, medium, and large tractors,[2] to do specific operations, is presented next in order. The following two sections present the cost of operating farm tractors, trucks, and other major farm machinery, and show the cost of operating auxiliary tractor-drawn equipment. The final section indicates some of the changes that have been taking place since the introduction of mechanical power and equipment to the Upland farms, and summarizes the study.

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(2) See Table 4 for classification of tractors.

FARM ORGANIZATION

The Upland areas of Mississippi are among the most diversified farming areas in the United States. Many systems of farming are followed with success in the areas.

In the Clay Hills area, cotton is the principal cash crop, although the acreage so used has declined considerably in recent years. For example, between 1940 and 1945, the cotton acreage in the area was reduced 49 percent, however, during the next 5 years the trend turned back up slightly to give a net decrease of 39 percent between 1940 and 1950. As the acreage was reduced, the increase in use of improved practices helped keep the total production up and even increased it slightly. During this same 10-year period the acreage in corn declined about 17 percent with a better than 65 percent increase in production, due primarily to better land selection, higher fertilization rates, and the use of other improved practices. With the decrease of cotton acreage in the area more land was shifted to feed crops and pasture, thus increasing the cattle sales and milk production as shown in Table 2.

Table 2. The acreage, production, and value of two major crops, and miscellaneous livestock data, for Brown Loam and Clay Hills areas during specified periods.*

Item	Unit	Area					
		Brown Loam 1			Clay Hills 2		
		1940	1945	1950	1940	1945	1950
Cotton:							
Acres	Acres	553.916	497,964	498.277	723,918	371,473	444.675
Production	Bales	309.483	358.925	456,604	160,981	274,169	173 465
Value (lint)	Dollars	14,716,791	37,572,687	38,346,123	6 408,254	27,825,947	29,284,508
Corn:							
Acres	Acres	751,331	591.293	459,950	656,955	607.499	546,495
Production 3/	Bushels	9,020,621	8.363.184	7,383,783	6,249,964	10.496,856	10.445,409
Value	Dollars	6,261,562	12,792,770	9,880,519	4,795,590	15,486,919	12,901,923
Cattle and calves sold alive	Number	84.061	122 581	160,178	63.754	90.206	101,252
Milk produced	Gallons	35,459 967	35,746,802	4/	39,572,328	41,115,954	4/

* Source: United States Census of Agriculture.
1/ Brown Loam area as shown in Figure 1.
2/ Clay Hills area, excluding Tishomingo and Itawamba Counties.
3/ Production of corn on acres where harvested for grain.
4/ Unavailable.

In most sections of the Brown Loam area, cotton is still a major, although declining, source of income. Acreage planted to cotton in the area did not decrease as sharply as in the Clay Hills area, but did decline about 10 percent from 1940 to 1950. However, the total production increased considerably during the same period. The acres in corn in the Brown Loam area were reduced much more than shown for the Clay Hills area, however, the decrease in cotton and corn in the Upland areas and in the state has been offset by an increase in pastures and other feed crops.

The Brown Loam area exceeded the Clay Hills area in the number and the percent increase of livestock sold alive from 1940 to 1950. Even with a large increase in the number of cattle and calves, not as much milk was produced in the Brown Loam area as in the Clay Hills area, indicating the extent to which beef cattle tended to dominate Brown Loam farms. These changes were not restricted to mechanized farms, but were common to all farms in the areas.

Total Acres of Cropland Associated With Size of Tractor

Total acres of cropland is used as the criterion in Table 3 to show what size tractors were associated with small, medium, large and very large farms. The very small and small 1-row tractors, accounted for 66 percent of all tractors

Table 3. Number of tractors of different sizes, by acres of cropland, on 178 farms, Upland areas, Mississippi, 1949.

Size of Tractor	Size of farm/1											
	Small			Medium			Large			Very Large		
	Number 2/		Av. per farm rep't	Number 2/		Av. per farm rep't	Number 2/		Av. per farm rep't	Number 2/		Av. per farm rep't
	Farms rep't	Tractors		Farms rep't	Tractors		Farms rep't	Tractors		Farms rep't	Tractors	
Very small	25	25	1.0	13	13	1.0	3	4	1.3	1	1	1.0
Small	14	14	1.0	19	19	1.0	4	4	1.0	1	1	1.0
Medium	19	19	1.0	33	33	1.0	38	45	1.2	12	20	1.7
Large	1	1	1.0	-	-	-	3	3	1.0	7	7	1.0
Totals	58	59	1.0	64	65	1.0	43	56	1.3	13	29	2.2

1/ By acres of cropland: small farms 40 or less acres; medium farms 41-80 acres; large farms 81-200 acres; very large farms 201 or more acres.

2/ Total number of farms reporting, may be less than number reporting each size of tractor due to one farm reporting two different sized tractors.

found on the small farms, with the majority of these being in the very small classification. On medium farms 51 percent of the tractors were of the medium size, with the small tractor leading in proportion on the remainder. Both small and medium farms averaged having only one tractor per farm. Therefore, as the acreage of cropland increased, the size of tractor ordinarily would need to be larger. There were more tractors per farm, and larger tractors, on the large and very large farms. Approximately 83 percent of the tractors on large farms and 93 percent of those on very large farms were 2-row in size.

Organization of Tractor Farms by Number and Size of Tractor

The number and size of tractor was used as the main criterion in order to get a deeper understanding of the organizational characteristics associated with levels of mechanization. To a large extent this measure was quite similar to the breakdown by acres of cropland as shown in Table 3. In this study tractors were sized somewhat differently than is generally done in mechanization studies. First, the division in sizes of tractors was by number of rows usually handled in cultivation (1-or 2-row). Cultivation of crops comprised about one-third of all work performed on Upland farms by tractors. The 1-and 2-row tractors were classified by drawbar horsepower. It is believed that a classification of this nature tends to group tractors more in line with rates of accomplishments than one based on drawbar horsepower alone. Of course, the two are closely related, but there was some contradiction, and where this occurred, rows cultivated was the size determinant. Large tractors can handle 4-row equipment, and generally do, in level areas. However, the rougher topography in Upland areas renders this physically impossible on a large scale. Some of the more common makes of tractors, and their classifications, are listed in Table 4.

Tenure and land-use organization, according to Table 5, indicate that size and number of tractors usually varied with the acres of cropland and total acres operated. Farms with only one tractor were relatively small in comparison to the farms where there was more than one. The farms which had more than one tractor averaged about three times as large as the

Table 4. Size of tractor by number of rows of usual cultivating attachments, and/or maximum drawbar horsepower rating by Nebraska tractor test.

	Size of Tractor			
Make	Very small 1-row D.H.P. (11 or less)	Small 1-row D.H.P. (12-18)	Medium 2-row D.H.P. (12-24.4)	Large 2-or 4-row D.H.P. (24.5 or more)
		Models		
Allis-Chalmers	G	B	C, RC WC, WD	U
Avery	V*		A*	
Case		V*, VA*	CC, RC, SC, VC, VAC	DC
Cockshutt				30
John Deere	L	LA, M,	MT, H, BN*, B	A, AN*, G,
Eagle			6B*	
Ferguson			TO-20	
Ford			9N, 2N*, 8N	
Gibson			B	I
Huber			B	LC, SC*
I. H. C.	Cub	A	B, C, H, F 14, F 20	M, MD, F 30
Intercontinental				C26, D26
Massey-Harris	Pony		20 Rowcrop* "81" RC, 101, Jr. "RC"	30 Rowcrop 44 Rowcrop*, "CH". "RC", 101 Super
Minneapolis-Moline			RTU	UTU, ZAU*, ZTU
Oliver			60HC, 70HC, 66HC GG	77HC, 80 HC, 88HC
Silver King				349,342*

* Not rated by Nebraska tractor tests.

single tractor farms. Also, cropland and total acreage operated were usually about twice as much, where 2-row tractors were being used. Some farmers, especially in the more level areas, reported 1-row tractors, but indicated the use of these tractors as a transitory power from workstock to 2-row tractors.

Cropland organization, by number and size of tractor. (Table 6), shows that cropper operations represented a greater proportion of the total operations on the 2-row tractor farms, and the farms where there was more than one tractor. This was due chiefly to larger acreage. After farms were grouped by number and size of tractor, cotton still maintained the dominant position as the major enterprise for both operators and croppers in every group. Corn occupied the next place of importance in the crop enterprises, with an average of about 33 percent of the planted acreage. Farms which had more than one tractor tended to emphasize oats, soybeans, and hay crops, and in general, had more acreage handled by operators and wage hands.

The average acreage of each crop enterprise for both operators and croppers is shown in Table 6.

Livestock organization, as shown in Table 7, indicated that the number of different kinds of livestock

Table 5. Tenure and land-use organization, by number and size of tractor, on 178 farms, Upland areas, Mississippi, 1949.

	Number of tractors per farm						Av. per operating unit
	One				More than one		
	Size of tractor				Size of tractor		
Item	Very small	Small	Medium	Large	Medium only	Multi-size	
	Average acres per farm (1)						
Tenure:							
Land owned	79.1	100.2	182.2	330.5	498.9	634.3	195.2
Land rented in	35.5	36.8	31.0	......	110.6	28.2	36.1
Land rented out	1.4	2.5	6.2	94.0	......	5.7	5.1
All land operated	113.2	134.5	207.0	236.5	609.5	656.8	226.2
Land-use organization:							
Cropland	38.4	52.1	80.3	116.0	311.6	311.1	94.7
Planted	33.2	47.6	73.1	57.5	254.1	305.7	85.8
Idle	5.2	4.5	7.2	58.5	57.5	5.4	8.9
Pasture:	46.1	62.4	80.9	105.0	207.4	253.0	89.2
Open permanent	14.5	18.2	32.3	80.0	129.9	165.3	41.0
Woodland	31.6	44.2	48.6	25.0	77.5	87.7	48.2
Woodland	21.8	14.5	34.6	......	26.0	68.7	29.7
Wasteland	6.9	5.5	11.2	15.5	64.5	23.9	12.6
No. of farms	37	37	80	2	8	14	1.0
No. of tractors	37	37	80	2	18	35	1.2

(1) For number of farms reporting and average per farm reported see Table 1 in Appendix.

Table 6. Cropland organization, by number and size of tractor, on 178 farms, Upland areas, Mississippi, 1949.

	Number of tractors per farm						Av. per operating unit
	One				More than one		
	Size of tractor				Size of tractor		
Item	Very small	Small	Medium	Large	Medium only	Multi-size	
	Average planted acres per farm (1)						
Cotton:							
Operator	12.8	17.2	15.9	7.5	31.8	28.5	17.2
Cropper	.5	2.2	14.6	22.5	51.1	86.9	16.5
Corn:							
Operator	10.9	14.9	19.6	23.5	59.0	27.2	19.2
Cropper	.7	2.5	8.9	......	23.8	46.5	9.4
Oats:							
Operator	.1	1.1	1.6	......	30.9	19.4	3.9
Cropper	......	......	......	......	......	4.3	.3
Hay, lespedeza:							
Operator	1.6	3.6	1.9	......	30.0	20.4	4.9
Cropper	......	.2	.4	......	......	5.7	.7
Hay other:							
Operator	3.7	4.4	8.0	1.5	15.2	61.4	10.8
Cropper	......	*	.2	......	......	5.7	.5
Soybeans:							
Operator	1.3	......	1.6	......	10.0	2.3	1.6
Cropper	......	......	.2	......	......	.2	.1
Truck Crops:							
Operator	1.4	1.5	.7	......	3.1	1.7	1.2
Cropper	......	.1	.1	......	......	4.3	.4
All other crops: (2)							
Operator	.3	.8	.8	2.5	8.2	11.2	1.9
Cropper	......	......	*	......	......	.4	.1
Total acres:							
Operator	32.1	43.5	50.1	35.0	188.2	172.1	60.7
Cropper	1.2	5.0	24.4	22.5	74.9	154.0	28.0
Total acres of crops	33.3	48.5	74.5	57.5	263.1	326.1	88.7
Less acres double cropped	.1	.9	1.4		9.0	20.4	2.9
Total acres cropland	33.2	47.6	73.1	57.5	254.1	305.7	85.8
No. of farms	37	37	80	2	8	14	1.0

* Less than .05 acres.
(1) For number of farms reporting and average per farm reported see Table 2 in Appendix.
(2) Cover crops, grain sorghums, clovers, sudan grass, millet, and sorghum.

varied with the number and size of tractor. The average numbers per farm of workstock, cattle, hogs, sheep, goats, and poultry are shown in Table 7.

Table 7. Livestock organization, by number and size of tractor, on 178 farms, Upland areas, Mississippi, 1949.

	Number of tractors per farm						Av. per operating unit
	One				More than one		
	Size of tractor				Size of tractor		
Item	Very small	Small	Medium	Large	Medium only	Multi-size	
	Average number per farm						
Workstock	1.2	2.0	3.5	3.0	7.2	8.9	3.3
Cattle:							
Milk cows	4.3	3.8	6.0	2.0	11.2	7.8	5.5
Other cattle	5.2	6.9	13.4	44.5	47.1	67.2	16.4
Hogs:							
Brood sows	.6	.9	1.0	.5	2.6	1.5	1.0
Other hogs	3.5	6.1	8.1	6.0	18.4	9.4	7.3
Sheep	-------	-------	-------	-------	-------	3.7	.3
Goats	-------	1.4	.6	-------	-------	-------	.6
Poultry:							
Hens and pullets	56.1	74.8	65.4	30.0	197.5	76.8	71.9
Broilers	-------	-------	25.0	-------	-------	-------	11.2
Turkeys	1.4	9.5	-------	-------	-------	-------	2.3
Ducks	.8	-------	.1	-------	-------		.2
Geese	.1	-------	-------	-------	-------	-------	*
Guineas	.7	-------	-------	-------	-------	-------	.1
No. of farms	37	37	80	2	8	14	1.0
No. of tractors	37	37	80	2	18	35	1.2

* Less than .05.
(1) For number of farms reporting and average per farm reported see Table 3 in Appendix.

Kinds of machinery used on farms studied represented a wide variety of tractor-drawn equipment Table 8. Most of this variation was reported on a relatively small number of farms, with most farmers reporting only a few basic implements. Farms with large tractors generally reported more machinery and equipment. Relatively expensive items, such as side-delivery rakes, bull rakes, binders, manure spreaders, ensilage cutters, grain drills, etc., were not reported on 1-row tractor farms. This is because such farms are somewhat smaller and cannot afford the investment in special equipment for the small amount of work done.

Farms with one very small tractor reported their most common tractor-drawn machines were a moldboard plow, disc harrow, section harrow, planter, mower and cultivator. The small tractor group, generally, reported a bush and bog disc, disc harrow, section harrow, and cultivator. Farms with one medium tractor usually reported a farm truck and trailer, bush and bog disc, disc harrow, middle-buster, section harrow, cultivator, mower, and lime spreader.

Of course, farms with more than one tractor reported even more equipment. For example, the groups of farms with two or more medium tractors had listed as usual equipment a combine, truck, trailer, moldboard plow, bush and bog disc, disc harrow, middle-buster, section harrow, planter, fertilizer distributor, cultivator, mower, and grain drill.

Table 8. Percent of farms reporting specified kinds of tractor and workstock equipment, and most common size implements on farms, by numbe and size of tractor, Upland areas, Mississippi, 1949.

Machine	Percent of farms reporting by number and size of tractor						Most common size machines on farms by number and size of tractor					
	Number of tractors per farm						Number of tractors per farm					
	One				More than one		One				More than one	
	Very small	Small	Medium	Large	Medium only	Multi-size	Very Small	Small	Medium	Large	Medium only	Multi-size
Farm truck:	32	35	64	100	100	78	½-ton	½-ton	½-ton	1½-ton	1½-ton	1½-ton
Farm trailer:	24	38	46	.....	75	93	1-B /2-W	1-B /4-W	1-B /4-W	.....	2-B /4-W	1-B /4-W
Tractor equipment:												
Breaking plow:												
Moldboard	59	38	29	50	50	21	1-plow	1-plow	2-plow	2-plow	2-plow	2-plow
Disc	16	19	26	.....	38	50	1-disc	2-disc	2-disc	.....	2-disc	sulky
Disc:												
Bush and bog	35	43	48	.....	62	78	5-foot	5-foot	6-foot	.....	6-foot	6-foot
Harrow	59	49	66	100	100	93	5-foot	6-foot	6-foot	6-foot	6-foot	6-foot
Middle-buster	40	38	52	100	100	86	1-row	2-row	2-row	3-row	2-row	2-row
Section harrow	46	46	41	50	75	71	3-row	3-row	4-row	4-row	4-row	3-row
Planter	51	32	41	.....	75	86	1-row	1-row	2-row	.....	2-row	2-row
Fertilizer distri.	16	32	36	.....	50	71	1-row	1-row	2-Row	.....	2-row	2-row
Cultivator	100	86	76	100	100	100	1-row	1-row	2-row	2-row	2-row	2-row
Mower	57	27	26	50	75	86	4½-foot	6-foot	7-foot	7-foot	6-foot	7-foot
Hay rake, S. D.	.....	.....	4	.....	38	50	.....	.....	10-foot	.....	10-foot	10-foot
Grain drill	.....	3	5	.....	50	43	.....	8-foot	6-foot	.....	10-foot	10-foot
Lime spreader	5	11	5	50	12	7	10-foot	8-foot	12-foot	12-foot	10-foot	9-foot
Poison machine	5	11	6	.....	12	36	2-row, H.	2-row, H.	6-row	.....	6-row	8-row
Cultipacker	3	3	1	.....	.....	7	5-foot	5-foot	8-foot	.....	.....	8-foot
Combine	3	3	12	.....	75	57	5-foot	5-foot	5-foot	.....	5-foot	5-foot
Hay baler:												
Pick-up	3	8	1	.....	25	14	.....	.....	.....	.....	.....	.....
Stationary	.....	3	6	.....	38	28	.....	.....	.....	.....	.....	.....
Bull rake	.....	.....	1	.....	12	.....	.....	.....	8-foot	.....	10-foot	.....
Binder	.....	.....	4	.....	12	7	.....	.....	1-row	.....	1-row	1-row
Stalk cutter	.....	.....	1	.....	12	.....	.....	.....	2-row	.....	2-row	.....
Manure spreader	.....	.....	..	.....	12	14	.....	.....	.....	.....	.....	.....

(Continued) Table 8. **Percent of farms reporting specified kinds of tractor and workstock equipment, and most common size implements on farms, by number and size of tractor, Upland areas, Mississippi, 1949.**

Machine	Percent of farms reporting by number and size of tractor						Most common size machines on farms by number and size of tractor					
	Number of tractors per farm						Number of tractors per farm					
	One				More than one		One				More than one	
	Very small	Small	Medium	Large	Medium only	Multi-size	Very small	Small	Medium	Large	Medium only	Multi-size
Ensilage cutter			1	50	12	14			medium	large	medium	medium
Feed grinder	8	5	3		12	14	small	medium	medium		medium	medium
Sorghum mill			1						medium			
Cut-off saw	5	5	1				26-in.	30-in.	30-in.			
Mule equipment:												
Wagon	40	43	60	50	38	78						
Moldboard plow	78	78	78	50	100	86	7-in.	7-in.	7-in.	7-in.	7-in.	7-in.
Disc	19	22	14			28	4-foot	4-foot	4-foot			4-foot
Middle-buster	59	76	78	50	100	93	10-in.	10-in.	10-in.	10-in.	10-in.	10-in.
Section harrow	27	49	56	50	38	64	2-row	2-row	2-row	3-row	3-row	3-row
Planter	62	73	80	100	100	100	1-row	1-row	1-row	2-row	1-row	1-row
Cultivator	35	51	56	50	62	57	1-row	1-row	1-row	1-row	1-row	1-row
Gee whiz	38	49	65	50	88	64	½-row	½-row	½-row	½-row	½-row	½-row
Georgia stock	46	73	74	50	100	78	½-row	½-row	½-row	½-row	½-row	½-row
Double shovel	3	3	8		25		½-row	½-row	½-row		½-row	
Fertilizer distri.	40	62	52	50	88	100	1-row	1-row	1-row	1-row	1-row	1-row
Grain drill			4		12				5-foot		7-foot	
Mower	16	27	38	50	25	57	4½-foot	4½-foot	4½-foot	5-foot	4½-foot	4½-foot
Hay rake, dump	14	35	34	100	88	64	10-foot	10-foot	10-foot	10-foot	10-foot	10-foot
Hay baler		5	1					medium	medium			
Bull rake		3	3			7		8-foot	8-foot			8-foot
Manure spreader	3						medium					
Stalk cutter		3	3					1-row	1-row			
Sorghum mill		3				7		medium				medium
Binder			3			7			1-row			1-row
Poison machine					12						2-row	
No. of farms	37	37	80	2	8	14	XX	XX	XX	XX	XX	XX

The size of the various implements and tractor-drawn machines was determined largely by the size of tractor with which they were used. For combines, the 5-foot size was most common. The one-half ton pick-up was the most common truck used for all but those with large tractors, which generally had a one and one-half ton truck.

In addition to tractor-drawn machinery, most farms reported mule-drawn implements such as a moldboard plow, middle-buster, section harrow, planter, cultivator, fertilizer distributor, gee whiz, and Georgia stock.

USE OF TRACTORS AND WORKSTOCK

The use (both amount and kind) of tractors on farms depends upon several factors. One, and probably the most important, is size of the farm. A second, also of major importance, is the system of farming. Additional factors are the size of the tractor and use of workstock.

This section is intended to "shed light" on the utilization of various kinds of tractors in Upland areas. Only average data by size of tractor are examined in the text, as this is probably more meaningful from most points of view. Details are presented in Appendix Tables 4 through 12.

On an average, tractors were used 549 hours, and covered the equivalent of 619 acres once over. Heavy work (consisting of discing, flat breaking, bedding, and combining with a power take-off) accounted for 40 percent of the total work done by tractors. Light work (such as planting, cultivating, fertilizing, mowing, etc.) comprised 60 percent.

Heavy Work

Tractors were used an average of 221 hours, and workstock 45 hours, at heavy work. Land preparation, such as breaking, discing, and bedding, was the only heavy work done by very small tractors, Table 9. However, where other sized tractors were used, a small amount of combining was reported in addition to these operations.

Disc. This operation, common to all tractor farms, and one of the heaviest for tractor work, accounted for a large percent of total heavy work. Discing accounted for 55, 60, 61, and 62 percent of the heavy work done by very small, small, medium, and large tractors, respectively. A disc harrow or bush and bog disc was the usual implement. The usual size of the disc depended chiefly upon the drawbar horsepower of the tractor.

Discing by workstock on tractor farms was of no significance.

Break. This operation was usually performed by tractors with a moldboard or disc plow. Tractors were used an average of 47 hours in breaking land. Very small tractors were used for breaking about 39 hours; small tractors, 47 hours; medium tractors, 50 hours; and large tractors, 45 hours.

Use of workstock for breaking land was of minor significance. Most of this was by croppers on large farms.

Bed. With the introduction of size-adapted and quickly attachable breaking plows, the practice of preparing land for row crops with

Table 9. Summary of utilization of 206 tractors and workstock (1), by size of tractor and operations performed, on 178 farms, Upland areas, Mississippi, 1949.

Operation	Size of tractor											
	Very small			Small			Medium			Large		
	Utilization of			Utilization of			Utilization of			Utilization of		
	Tractors		W tock	Tractors		W tock	Tractors		Wstock	Tractors		W tock
	All tractors	All farms	All farms	All tractors	All farms	All farms	All tractors	All farms	All farms	All tractors	All farms	All farms
	Average (2)											
Heavy Work:												
Disc:												
10-hour days	7.3	7.4	.....	10.0	10.0	*	15.9	18.2	....	19.9	19.9	....
Acs. OOE**	55.4	56.8	..	111.7	111.7	.1	209.4	240.8	....	405.3	405.3	....
Break:												
10-hour days	3.9	4.0	.9	4.7	4.7	.3	5.0	5.7	1.9	4.5	4.5	....
Acs. OOE	13.9	14.2	1.4	25.0	25.0	.5	36.3	41.8	5.8	39.3	39.3	....
Bed:												
10-hour days	2.1	2.2	.9	1.9	1.9	2.0	4.5	5.2	3.7	6.2	6.2	12.1
Acs. OOE	15.8	16.2	6.0	22.8	22.8	10.3	72.0	82.8	21.3	94.2	94.2	65.7
Combine, P.T.O.:												
10-hour days	....	....	....	.1	.1	....	.7	.8	....	1.4	1.4	....
Acs. OOE	....	....	....	.8	.8	....	6.6	7.6	....	16.4	16.4	....
Total heavy work:												
10-hour days	13.3	13.~~8~~ 6	1.8	16.7	16.7	2.3	26.1	29.9	5.6	32.0	32.0	12.1
Acs. OOE	85.1	87.2	7.4	160.3	160.3	10.9	324.3	373.0	27.1	555.2	555.2	65.7
Light work:												
Plant:												
10-hour days	2.0	2.0	2.2	1.5	1.5	4.6	2.2	2.5	6.2	....	....	9.1
Acs. OOE	14.7	15.0	14.6	12.3	12.3	33.3	36.5	42.0	41.9	....	....	96.7
Cultivate:												
10-hour days	15.2	15.6	4.4	14.8	14.8	12.7	15.4	17.7	27.3	8.8	8.8	88.2
Acs. OOE	120.6	123.5	28.9	132.1	132.1	78.4	238.3	274.1	138.1	167.6	167.6	419.9
Harrow:												
10-hour days	1.9	1.9	.4	3.4	3.4	.8	3.2	3.7	1.1	3.4	3.4	4.8
Acs. OOE	34.7	35.5	3.9	72.4	72.4	6.8	94.5	108.7	14.6	130.4	130.4	72.7

(Continued) **Table 9. Summary of Utilization of 206 tractors and workstock (1), by size of tractor and operations performed, on 178 farms, Upland areas, Mississippi, 1949.**

Operation	Size of tractor											
	Very small			Small			Medium			Large		
	Utilization of			Utilization of			Utilization of			Utilization of		
	Tractors		W-tock	Tractors		W-tock	Tractors		W-tock	Tractors		W-tock
	All tractors	All farms	All farms	All tractors	All farms	All farms	All tractors	All farms	All farms	All tractors	All farms	All farms
	Average (2)											
Mow:												
10-hour days	3.7	3.8	*	.9	.9	.4	2.7	3.1	.6	1.6	1.6	.5
Acs. OOE	40.3	41.3	.4	9.5	9.5	2.7	51.3	59.0	3.7	29.5	29.5	2.3
Fertilize:												
10-hour days	.4	.4	.6	.2	.2	.9	.5	.6	1.9	....	....	5.6
Acs. OOE	2.9	2.9	3.4	1.6	1.6	5.9	7.2	8.3	15.3	....	....	45.2
Comb. with motor:												
10-hour days	....	....	....	....	....	....	.4	.4	....	....	....	....
Acs. OOE	....	....	....	....	....	....	3.6	4.1	....	....	....	....
Belt work:												
10-hour days	1.9	2.0	....	.7	.7	....	2.2	2.6	....	2.5	2.5	———
Haul:												
10-hour days	4.8	4.9	1.1	10.4	10.4	1.5	4.7	5.4	3.1	5.5	5.5	9.2
Other work (3):												
10-hour days	.9	.9	....	.9	.9	.4	3.3	3.8	.2	1.2	1.2	
Acs. OOE	23.8	24.3	....	23.6	23.6	1.1	14.1	16.2	1.0	7.3	7.3	—
Total light work:												
10-hour days	30.8	31.5	8.7	32.8	32.8	21.3	34.6	39.8	40.4	23.0	23.0	117.4
Acs. OOE	237.0	242.5	51.2	251.5	251.5	128.2	445.5	512.3	214.6	334.8	334.8	636.3
Total work:												
10-hour days	44.1	45.1	10.5	49.5	49.5	23.6	60.7	69.7	46.0	55.0	55.0	129.5
Acs. OOE	322.1	329.7	58.6	411.8	411.8	139.1	769.8	885.3	241.7	890.0	890.0	~~708.0~~ [illegible]
No. of farms		41			38			100			11	
No. of tractors		42			38			115			11	

* Less than .05

** Acres covered once over equivalent.

(1) Average number of workstock by size of tractor per farm: very small-2.2; small-2.2; medium-4.5; large-10.5.

(2) For percent of farms and tractors reported, see Tables 9-12 in Appendix.

(3) See footnotes on individual utilization tables in Appendix.

middle-busters is changing somewhat. The usual practice for seedbed preparation at the time of this study was to prepare the land flat, then "hip it up" with cultivator sweeps, rather than to make up high beds. Comments by Upland farmers, as well as the percent owning middle-busters, tended to indicate a decline in importance of the tractor-drawn middle-buster. However, some bedding is still practiced. An average of 36 hours per tractor was reported on the farms studied. Two-row tractors were used more than twice as many hours for bedding as 1-row tractors.

Bedding with workstock was done to a small extent on all farms. However, most of it was confined to cropper operations on large farms.

Combine with power take-off

This operation was significant only on farms where the large 1-row, and 2-row tractors were found. The most common sized combine reported was 5-foot in width. Of course, the very small tractors could not handle a power take-off operated machine of this size. Also, crops ordinarily combined were found more frequently on the large farms.

Light Work

The first farm tractors were used principally for discing and land preparation, but today tractor implements are adapted to almost every job on the farm. As shown earlier, light work comprised 60 percent of all work done with the tractors studied. Eighty-eight percent of all work done by mule power was classified as light work. Comments of farmers indicated that most operations performed by work stock will gradually be shifted to mechanical operation. This change will take place as workstock on hand die, and as more tractor equipment becomes available and farmers become more proficient in using tractors.

Plant. Tractor-drawn planting equipment was either 1-or 2-row in size, generally depending upon the size of cultivating attachments. About one-half of the farmers had planting attachments, see Table 11. Planting equipment was not so plentiful even in 1949; therefore, some farmers were of necessity using mule planters and workstock for this operation. As shown in Table 9, approximately half of the planting was done by workstock where very small tractors were used. This was true to an even larger extent where other tractors were used. In fact, no planting was done by large tractors. Where they were used, planting was done either by 2-row mule-drawn planters or custom hired.

Cultivator. Tractor power was used for cultivating on a larger proportion of the acreage than for any other operation. Very small and small tractors used 1-row cultivating equipment, while the medium and large tractors used 2-row equipment. No. 4-row cultivating equipment was reported, although large tractors can handle that many rows. Problems introduced by topography are responsible for this. In the Delta and other level areas, 4-row equipment is used with large tractors. Some farmers did not have cultivating equipment for their tractors, and depended upon workstock for cultivation. Croppers did most of their cultivating with workstock, as indicated by the large amount of workstock cultivation on large farms.

Cultivation required more time than any other single operation, with an average of 149 hours per tractor, or 27 percent of all work. This operation accounted for 230 hours of the 387 hours workstock were used, or 59 percent of all work done by workstock. The usual workstock cultivating equipment was a 1-row cultivator, drawn by two mules. However, nearly all farms had ½ row cultivating equipment, such as a Georgia stock and a gee whiz.

Harrow. This operation usually preceded planting, but was also occasionally used shortly after planting to break the crust on the surface of the soil. Tractor harrows usually were 3-or 4-row in size, and workstock harrows, 2-row. Harrowing was generally considered as heavy work for workstock, but light to medium work for tractors. Ordinarily, this operation did not take up many days, as a considerable number of acres could be covered during a day. Harrowing required an average of 30 hours for tractors, and 11 hours for workstock.

Mow. This operation was of most significance where very small tractors were used. In fact, some custom mowing with very small tractors was practiced. Where the very small tractor was associated with other sized tractors, the majority of the mowing was done with it.

For all tractors an average of about 25 hours was spent mowing. The usual width of the mower for the very small tractor was 4½ ft. although mowers as large as 7-foot were used in some instances. The usual mowers for other sized tractors were 6-and 7-foot in width.

Mowing with workstock was seldom practiced on farms with very small tractors. However, mule mowing was of some importance on small, medium, and large tractor farms. On all farms, workstock were utilized an average of four hours for mowing.

Fertilize. Application of fertilizer by tractors as a single operation was not so prevalent on Upland tractor farms. Tractors were used an average of only four hours for this operation. On the other hand, workstock were used an average of 16 hours per farm. The usual tractor fertilizer attachments were 1-or 2-row, while workstock distributors generally were 1-row. Additional fertilization by tractors was done as a combined operation with planting and making beds with rear cultivator sweeps. Some side dressing was reported in combination with cultivation.

Combine with auxiliary motor. The usual combine on Upland tractor farms was 5-foot in size and power take-off operated. Some farmers, however, reported auxiliary motor-powered combines of 5-and 6-foot size. Such combines were reported only on farms where medium tractors were used. An average of four hours of combining per medium tractor was reported.

Belt work. An average of 19 hours of belt work per tractor was reported. The usual belt work consisted of grinding feed, and powering cut-off saws, stationary hay balers, and sorghum mills. Very small, small, medium, and large tractors were used 19, 7, 22, and 25 hours, respectively, for this operation.

Haul. Tractor power for hauling predominated in every group, except where large tractors were used. Farms in this group, being somewhat larger, had more workstock and croppers; thus more hauling by workstock and/or truck would be expected. Tractors and workstock were used an average of 58 and 27 hours, respectively, for hauling.

Other work. Tractors were used for many other jobs, such as drilling oats, bailing hay, raking hay, cultipacking, lime spreading, row binding, and building terraces. Workstock did other work than that summarized, such as raking hay, opening rows, listing with a turning plow, and garden work.

In most cases, use for these purposes was of minor importance, and did not warrant separate examination. Utilization of tractors for other work averaged 23 hours per tractor. The farm group having a medium-sized tractor did more of this type of work.

Summary of the utilization of 206 tractors and workstock, by size of tractor and operation performed, is shown in Table 9. The utilization data presented in Table 9 include custom work done for others. For specific details about this custom work, see Tables 5 through 8 in the Appendix. Hired custom work where tractors were owned, was of little significance. One farm in the small tractor group hired 8 acres of oats combined. Two farms in the medium tractor group which had no tractor or mule planters hired a total of 40 acres planted. One other farmer in the same group had no fertilizer attachments for his tractor and no mule-drawn fertilizer distributor, so it was necessary for him to hire 50 acres of crops fertilized. Farmers in Upland areas indicated that after equipment becomes available, custom hire for tractor farmers would be narrowed down to perhaps combining grains and other specialty work.

OPERATIONS PERFORMED AND AVERAGE PERFORMANCE RATES BY SIZE OF TRACTOR

The amount of work a tractor can do in a ten-hour day depends upon several factors. One very important factor is drawbar horsepower of the tractor. Speed and size of the implement drawn depend, of course, upon the power generated. Considerable variations in rates of performance occur also in actual operations, due to the terrain, condition of the soil, urge to get work done, and capabilities and experience of the driver. Rates are likely to be higher with farmers who are experienced in handling tractors. Average performance rates, by operations performed and size of tractor, are shown in Table 10.

Land Preparation, Planting, and Cultivation

According to Table 6, the average tractor operating unit had approximately 60 acres of cotton and corn. In order to describe more fully some of the differences in performance rates of different sized tractors, comparisons are based on total time to perform the operation on 60 acres of such row crops. On the farms studied, the usual oper-

Table 10. Average performance rates, by operation performed and size of tractor, Upland areas, Mississippi, 1949.

Operation	Size of tractor							
	Very small		Small		Medium		Large	
	Acres per 10-hr. day	Hours per acre	Acres per 10-hr. day	Hours per acre	Acres per 10-hr. day	Hours per acre	Acres per 10-hr. day	Hours per acre
Break:								
Moldboard:								
1-plow	3.9	2.6	4.2	2.4	....	....		
2-plow	....	....	7.1	1.4	7.3	1.4	7.4	1.4
Disc:								
1-disc	3.2	3.1	4.1	2.4	4.4	2.3	....	....
2-disc	5.0	2.0	6.0	1.7	6.3	1.6	....	....
3- or 4-disc (sulky)	....	....	....	....	7.8	1.3	8.0	1.2
Disc:								
Bush and bog: (lap cut)								
4-foot	4.6	2.2	5.0	2.0	....	....		..
5-foot	6.0	1.7	6.5	1.5	7.1	1.4	..	....
6-foot	7.0	1.4	7.9	1.3	8.0	1.2	8.1	1.2
7-foot	....	....	9.6	1.0	10.7	.9	10.9	.9
Harrow:								
4-foot	7.4	1.4	....	....	....	....	....	....
5-foot	10.6	.9	11.9	.8	12.6	.8	....	....
6-foot	....	....	14.1	.7	16.3	.6	16.7	.6
7-foot	....	....	....	....	19.6	.5	20.1	.5
Bed and re-bed:								
1-row middle-buster	8.1	1.2	9.5	1.1	....	....	....	....
2-row middle-buster	12.5	.8	14.2	.7	16.2	.6	16.3	.6
3-row middle-buster	....	....	....	....	23.0	.4	24.0	.4

(Continued) **Table 10. Average performance rates, by operations performed and size of tractor, Upland areas, Mississippi, 1949.**

Operation	Size of tractor							
	Very small		Small		Medium		Large	
	Acres per 10-hr. day	Hours per acre	Acres per 10-hr. day	Hours per acre	Acres per 10-hr. day	Hours per acre	Acres per 10-hr. day	Hours per acre
Fertilize:								
1-row	7.9	1.3	7.9	1.3	......	......	......	......
2-row	......	......	15.9	.6	16.1	.6		......
Lime spreader:								
8-foot	......	......	......	......	20.0	.5	......	......
10-foot	25.0	.4	......	......	26.0	.4	25.8	.4
12-foot	......	......	......	......	31.5	.3	......	......
Cultivate beds before planting:								
Section harrow:								
2-row	16.3	.6	19.4	.5	19.7	.5	19.3	.5
3-row	24.1	.4	26.1	.4	28.5	.4	28.0	.4
4-row	......	~~.4~~	36.5	.3	37.1	.3	37.0	.3
Cultipacker:								
5-foot	12.0	.8	11.8	.8	......	......	......	......
8-foot	......	......	......	......	18.5	.5	......	......
Plant:								
1-row	7.6	1.3	8.0	1.2	......	......	......	......
2-row	17.0	.6	17.3	.6	17.2	.6	......	......
Grain drill:								
6-foot	......	......		......	12.5	.8	......	......
8-foot	......	......	16.5	.6	16.7	.6		......
10-foot	......	......		......	23.0	.4	22.8	.4
12-foot	......	......		......	28.6	.3	29.0	.3

(Continued) **Table 10. Average performance rates, by operations performed and size of tractor, Upland areas, Mississippi, 1949.**

Operation	Size of tractor							
	Very small		Small		Medium		Large	
	Acres per 10-hr. day	Hours per acre	Acres per 10-hr. day	Hours per acre	Acres per 10-hr. day	Hours per acre	Acres per 10-hr. day	Hours per acre
Plant, fertilize, and bed:								
1-row	7.8	1.3	7.9	1.3	......	......	......	......
2-row	......	......	......	......	16.0	.6	......	......
Cultivate:								
1-row	3.0	1.2	8.5	1.2	......	......	......	......
2-row	......	......	......	......	15.9	.6	16.3	.6
Poison:								
2-row, hand	12.5	.8	13.0	.8	12.5	.8	13.0	.8
6-row	......	......	......	......	39.0	.3	38.5	.3
8-row	......	......	......	......	......	......	50.0	.2
Mow:								
4½-foot	11.4	.9	11.2	.9	11.3	.9	......	......
5-foot	13.5	.7	13.4	.7	13.4	.7	......	......
6-foot	......	......	16.6	.6	16.7	.6	......	......
7-foot	......	......	19.3	.5	19.5	.5	19.4	.5
Rake hay:								
Side-delivery, 9-foot	30.3	.3	30.0	.3	31.0	.3	......	......
Bull rake, 8-foot	......	......	......	......	20.0	.5	......	......
Bale hay:								
Pick-up baler	......	......	......	......	10.0	1.0	......	......
Stationary baler	......	......	......	......	8.8	1.1	......	......
Pick corn:								
1-row	......	......	......	......	6.3	1.6	......	......
2-row	......	......	......	......	10.0	1.0	......	......

ations on row crops were flat breaking double discing, harrowing with a section harrow twice over, then planting, fertilizing, and bedding in one operation.

Flat breaking, double discing, and harrowing twice over will be considered land preparation for purposes of showing the performance of different sized tractors in preparing 60 acres of land. The most common implements indicated in Table 8 are assumed with each sized tractor.

According to the performance rates in Table 10, an average for all tractors of 23 ten-hour days was required for preparation on 60 acres of crops. Land preparation required 31.7 ten-hour days for the very small tractor, 27.4 ten-hour days for the small tractor, 18.8 ten-hour days for the medium tractor, and 17.9 ten-hour days for the large tractor. This indicates the considerable importance of drawbar horsepower in the speed of preparing land for planting.

Planting, fertilizing, and "hipping up" rows on 60 acres, in one operation, required 7.7, 7.6, and 3.8 ten-hour days for the very small, small, and medium tractors, respectively. Table 10.

Assuming that the 60 acres were cultivated five times, the very small tractor would need 37.5 ten-hour days to do this job. The small tractor (large 1-row) could cover the same 300 acres once-over equivalent in 35.3 ten-hour days. The additional speed in cultivation reported by small over very small tractors is not likely due to more horsepower in the tractor, but to a more suitable gear for cultivation. Some farmers, who had very small tractors, pointed out a need for a special cultivating gear between second (average 3.2 M.P.H.) and the high-speed (average 6.6 M.P.H.) road gear.

For the same acreage of cultivation, the medium tractor (2-row) needed only 18.9 days, and the large tractor (2-row), only 18.4 days. Here again horsepower is not likely the reason for the slightly higher performance rates by the large tractor. Most of the medium tractors and all of the large tractors have sufficient power to handle 4-row cultivating equipment.

Other Operations

Aside from cotton and corn, hay was the next most important crop on the farm studied, Table 6.

There were approximately 17 acres of all types of hay on the average operating units.

No very small tractors were reported as used for seeding hay. However, other sized tractors were used, and the power of tractor did have some influence on the rate of performance.

The power required for operating a mowing machine is not a major limiting or determining factor in the performance rates of different sized tractors for mowing hay. However, the mowers most commonly used with the very small and small tractors were of 4½ and 6-ft. sizes, respectively. The 7-ft. mower was the most common size used with medium and large tractors. Assuming the most common sized mower is used with each sized tractor, the 17 acres of hay would require 1.5, 1.0, .9, and .9 ten-hour days of mowing one time with the very small, small, medium, and large tractors, respectively. Since the power required is not a limitation, the very small tractor could easily mow approximately as much hay as any other sized tractor if the same sized mowers were used.

Raking hay with a side-delivery rake is another operation in which power of the tractor is not a determining factor in the performance rates. Even very small tractors have sufficient power to handle the side-delivery rake without difficulty.

Table 10 shows all operations performed by tractors on the farms studied. and the average performance rates for each sized tractor in doing these operations.

COST OF OPERATING TRACTORS, TRUCKS, TRAILERS, COMBINES, AND OTHER MAJOR FARM MACHINERY IN UPLAND AREAS, 1949

Tractors

Tractors included in this study were classified as very small, small, medium, and large, Table 4. The maximum drawbar horsepower averaged 9.5 for the very small, 15.3 for the small, 20.2 for the medium, and 31.3 for the large tractors.

Requirements and utilization. The fuel requirements of a tractor depend largely upon the horsepower developed and the drawbar load. Light work such as planting, cultivating, mowing, hauling, etc., required an average of 7.9 gallons of gasoline or 10.4 gallons of fuel oil per ten-hour day, Table 11. However, no very small tractors were operated on fuel oil. Gasoline requirements for light work averaged 4.7, 6.8, 9.0, and 13.2 gallons per ten-hour day for the very small, small, medium and large tractors, respectively.

Heavy work required much more gasoline or fuel oil for all tractors, with an average of 13.9 gallons of gasoline and 16.8 gallons of fuel oil. Gasoline requirements for heavy work averaged 7.4, 12.3, 16.3 and 20.0 gallons per ten-hour day for the very small, small, medium, and large tractors, respectively.

In estimating the gasoline needs for mechanical power, both size of tractor and number of days of expected use at different drawbar loads must be considered. Light work required an average of 55 percent of the total tractor use for the tractors included in the study. The percent used at light work for the very small, small, medium, and large tractors was 70, 66, 57, and 42, respectively.

On the average, oil was changed in all tractors every 86 hours. The hours of use between changes were 86, 98, 84, and 67, for the very small, small, medium, and large tractors, respectively. The average amounts of oil required per change was 5.3 quarts, with the very small tractor requiring only 3 quarts, while the large tractor required 7 quarts per change. The amount of oil added to all tractors between changes was 1.7 quarts, with the variation in amount required largely dependent upon the age and condition of the tractor.

Table 11. **Annual use, fuel requirements and related information for very small, small, medium, and large tractors, on 178 farms, Upland areas, Mississippi, 1949.**

Item	Unit	Size of Tractor				Av. all tractors
		V. small	Small	Medium	Large	
	Average per tractor					
Annual use:						
Light work:	10-hr. days	30.8	32.8	34.6	23.0	32.9
	Acs. OOE	237.0	251.5	445.5	334.8	361.5
Heavy work:	10-hr. days	13.3	16.7	26.1	32.0	22.1
	Acs. OOE	85.1	160.3	324.3	555.2	257.4
Total work:	10-hr. days	44.1	49.5	60.7	55.0	54.9
	Acs. OOE	322.1	411.8	769.8	890.0	618.9
Fuel requirements:						
Gasoline (run) (1)						
Light work	Gal. per day	4.7	6.8	9.0	13.2	7.9
Heavy work	Gal per day	7.4	12.3	16.3	20.0	13,9
Gasoline (start) (2)	Gal. per day	...	.2 (3)	.7	.7	.6(4
Fuel oil: (2)						
Light work	Gal. per day		6.0 (3)	11.4	15.0	10.4(4
Heavy work	Gal. per day	...	9.0 (2)	18.6	24.0	16.8(4
Related information:						
Freq. oil changed	Hours	86	98	84	67	86
Oil per change	Quarts	3	5	6	7	5.3
Oil added	Quarts	.7	1.6	2.1	1.7	1.7
Filter changed	Days of use	11.8	11.3	12.7	10.4	12.1
Freq. greased	Days of use	1.5	1.1	1.2	1.0	1.2
Service time	Min. per day	22	18	21	24	20.8
Min. mount eqp't	Per mounting	25	32	42	54	37.3
Eqp't mounted (yr)	No. of times	21	22	22	8	20.0
Freq. overhauled	Years	3.9	4.1	3.5	2.9	3.7
Est. life of tractor	Years	10	11	12	13	11.5
Est. life of tires:						
Front	Years	6.0	4.9	4.7	4.2	5.0
Rear	Years	6.2	5.4	5.3	5.2	5.5
M.H.P., drawbar	Horsepower	9.5	15.3	20.2	31.3	17.7
Purchase price, 1949	Dollars	988	1,430	1,656	2,397	1,516
Age of tractors	Years	1.8	2.3	4.7	2.9	3.6
No. of tractors		43	38	117	11	209

(1) Only tractors that used gasoline for running are included in average.
(2) Only tractors that used fuel oil for running are included in average.
(3) Only one tractor used fuel oil for running.
(4) Includes only tractors which reported item.

Oil filters were changed, on the average for all tractors, every 12.1 days of use, with no more than 2.3 days variation between the different sized tractors. Some tractors did not have oil filters, and others were changed only twice a year.

On the average, tractors were greased after every 1.2 days of use, with little variation for the different sized tractors. A few tractors had sealed-in grease fittings which ordinarily required servicing only about twice a year.

Approximately 21 minutes per day were spent servicing tractors. Service time required for the very small, small, medium, and large tractors was 22, 18, 21, and 24 minutes per day, respectively. Service time was not charged as a cost of operation in this study because most tractors were owner operated, and the alternative value of this labor is questionable.

The average time required for mounting all equipment on tractors was 37.3 minutes per mounting. Equipment was mounted on all tractors an average of 20 times a year. See Table 11 for minutes required to mount equipment and number of times equipment was mounted per year for each sized tractor.

Cost of operation. The total cost of operating tractors may be classified as either variable or fixed. Variable cost, as the name implies, depends upon the amount of use of the tractor, while the other, fixed cost, remains at essentially the same level regardless of amount of use of the machine.

Fuel expenditures accounted for 58 percent of the tractor variable cost, with an average of 49, 57, 59, and 61 percent, for the very small, small, medium, and large tractors, respctively. Table 12.

Repair costs, the other major variable cost item, constituted 35 percent of total variable cost, and 6 percent of the 1949 purchase price, for all tractors. Repairs included both the average cost of maintaining the tractor, and the annual share of overhauling expenses. Tractors included in this study were usually overhauled every 3 or 4 years, Table 11. To prevent this heavy expense from falling on one year's operation, it was necessary to allocate it annually. Repairs, as a percent of the total variable costs, were 43, 36, 34, and 32 for the very small, small, medium, and large tractors, respectively.

Other operating expenses included in the variable costs were oil, filters. and grease.

Fixed costs included interest, depreciation, insurance, and housing. These costs remained at about the same level for tractors purchased at a given price. Depreciation, which accounted for 70 percent of fixed costs for all tractors, depended upon the useful life of the tractor. Therefore, the tractor should be used properly and given good care, if a maximum useful life is to be expected.

Fixed cost accounted for an average of 41 percent of total costs for all tractors, with an average of 52, 48, 38, and 41 percent, for very small, small, medium, and large tractors, respectively, Table 12.

Table 12. Cost of operating very small, small, medium, and large tractors, - Upland areas Mississippi, 1949.

Cost Item (1)	Size of tractor											
	Very small			Small			Medium			Large		
	Dollars per			Dollars per			Dollars per			Dollars per		
	Day	Acs. OOE	Year	Day	Acs. OOE	Year	Day	Acs. OOE	Year	Day	Acs. OOE	Year
Variable costs:												
Fuel	1.26	.18	56.18	2.00	.24	~~98.7~~ 98.97	2.91	.23	176.44	3.96	.24	218.06
Oil	.10	.01	4.31	.16	.02	7.68	.22	.02	13.29	.29	.02	16.19
Filter	.04	*	1.53	.04	*	1.76	.04	*	2.45	.07	*	3.89
Grease	.06	.01	2.72	.06	.01	3.23	.06	*	3.45	.07	*	3.75
Repairs	1.11	.15	48.88	1.26	.15	62.22	1.66	.13	101.20	2.08	.13	113.95
Total	2.57	.35	113.62	3.52	.42	173.86	4.89	.38	296.83	6.47	.39	355.84
Fixed costs:												
Interest (2)	.56	.07	24.70	.72	.09	35.75	.68	.05	41.40	1.09	.07	59.92
Depreciation (3)	2.02	.27	88.92	2.36	.28	117.00	2.04	.16	124.20	3.02	.19	165.95
Insurance (4)	.11	.02	4.94	.14	.02	7.15	.14	.01	8.28	.22	.01	11.98
Housing	.06	.01	2.76	.06	.01	2.87	.08	.01	4.70	.13	.01	7.39
Total	2.75	.37	121.32	3.28	.40	162.77	2.94	.23	178.58	4.46	.28	245.24
Total costs	5.32	.72	234.94	6.80	.82	336.63	7.83	.61	475.41	10.93	.67	601.08
No. of tractors		42			38			117			11	
10-hour days used		44.1			49.5			60.7			55.0	
Acs. covered OOE		322.1			411.8			769.8			890.0	

* Less than .005.

(1) Gasoline computed at 23.1 cents per gallon, fuel oil at 15.3 cents per gallon, oil at 22.8 cents per quart, filters at 73.5 cents each, grease at 18.7 cents per pound.

(2) Computed at 5 percent of one-half the purchase price.

(3) Purchase price less 10 percent divided by average life expectancy.

(4) Computed at $1 per $100 on one-half purchase price.

The average total cost of operating all tractors was $7.42 per day. Total operating costs per day used for very small, small, medium, and large tractors were $5.32, $6.80, $7.83, and $10.93, respectively. The differences in average costs were caused largely by variations in fuel consumption and in purchase price (upon which depreciation and interest charges were based). The comparison of daily operating costs is not very significant because of the difference in performance rates, utilization, and the fact that the different sized tractors are not completely substitutable.

Motor Trucks

According to the Census of Agriculture, Mississipi had 28.267 trucks in 1945. During the next five years the number increased 99 percent, or to 56,210 trucks. Cost and requirement data for several sized trucks are shown in Tables 13 and 14.

Table 13. Annual use, fuel requirements, and related information for trucks of different sizes on farms, Upland areas, Mississippi, 1949.

Item	Unit	Size of truck				
		½ ton	¾ ton	1 ton	1½ ton	2 ton
		Average per truck				
Miles driven	Miles	5,846	8,242	5,374	8,149	6,833
Gasoline used	Gallons	487	749	537	905	854
Miles per gallon	Miles	12.0	11.0	10.0	9.0	8.0
Total oil used	Quarts	39	62	27	63	59
Freq. oil changed	Miles	1,000	1,000	1,000	1,000	1,000
Oil per change	Quarts	5	5	5	5	5
Oil added	Quarts	1.6	2.5	....	2.7	3.7
Purchase price, 1949	Dollars	1,525	1,610	1,738	2,086	2,363
Age of trucks	Years	5.3	5.6	1.8	7.1	2.0
Est. life of truck	Years	12.5	9.7	10.0	10.2	9.8
No. of trucks		44	12	4	25	6

Table 14. Cost of operating trucks of different sizes on farms, Upland areas, Mississippi, 1949.

Cost Item (1)	Size of truck				
	½ ton	¾ ton	1 ton	1½ ton	2 ton
	Dollars per truck				
Variable costs:					
Gasoline	146.10	224.70	161.10	271.50	256.20
Oil and filters	16.08	24.78	12.13	25.01	22.82
Grease	7.31	12.36	8.06	16.30	13.67
Tires and tubes	25.00	37.50	25.00	80.00	71.00
Repairs	46.75	70.06	51.05	95.00	82.40
Total	241.24	369.40	257.34	487.81	446.09
Variable costs per mile	.041	.045	.048	.060	.065
Fixed costs:					
License	9.32	10.04	10.33	20.16	32.14
Taxes	10.65	12.17	14.00	15.33	27.50
Interest	38.12	40.25	43.45	52.15	59.12
Depreciation	109.80	149.38	156.42	184.06	217.01
Housing	5.94	6.80	7.77	4.51	....
Total	173.83	218.64	231.97	276.21	335.77
Fixed cost per mile	.029	.026	.043	.033	.049
Total costs	415.07	588.04	489.31	764.02	781.86
Total cost per mile	.071	.071	.091	.094	.114

(1) The cost of items listed below are higher than for tractor computations because most of these items are ordinarily purchased in small amounts at service stations and at higher costs. Gasoline at $.30 per gallon, oil at $.30 per quart, filters at $1.50, grease job at $1.25, $1.50, $1.50, $2.00, and $2.00 for ½, ¾, 1, 1½, and 2 ton, respectively. Interest and depreciation are computed in the same manner as in Table 12.

Requirements and utilization. Trucks were driven an average of 6.839 miles, with the ¾ and 1½ ton trucks being driven slightly more than other sized trucks, Table 13. The miles per gallon of gasoline varied directly with the size of truck. Trucks averaged 10.3 miles per gallon, with an average of 12.0, 11.0, 10.0, 9.0, and 8.0 miles per gallon for the ½, ¾, 1, 1½ and 2 ton trucks, respectively. According to Table 13, oil was changed in most trucks every 1,000 miles and 5 quarts of oil were required per changes. Most trucks required the addition of some oil between changes. The amount added was determined largely by the age and mechanical condition of the truck. The average estimated life of trucks was 10.1 years, with ½ ton having the longest estimated useful life, Table 13.

Cost of operating trucks. The average total cost per mile of operating trucks was 7.1, 7.1, 9.1, 9.4, and 11.4 cents for the ½, ¾, 1, 1½ and 2 ton trucks, respectively. For all sized trucks, depreciation was the largest single item of cost. Depreciation constituted 32 percent of the total costs for the ½ ton trucks, and 34 percent for the 2 ton trucks, and averaged about one-third of total costs for all trucks. The expense for gasoline, depending both on the miles driven and miles per gallon, accounted for approximately 35 percent of the total operating costs per truck.

Other costs of major significance were repairs, tires and tubes, interest, and taxes. Fixed costs per mile were related closely to the miles the trucks were driven. Those which were driven the least miles had much higher fixed cost per mile. See Table 14 for specified costs in the Upland areas for each sized truck.

Farm Trailers

The operating costs and related information for 79 farm trailers are shown in Table 15. These trailers were sized by bales of seed cotton capacity and/or number of wheels. The average number of days of use for trailers was 26.9. The 1-bale, 2-wheel; 1-bale, 4-wheel; 2-bale, 4-wheel; and 3-bale, 4-wheel were used an average of 17.2, 24.3, 31.1, and 57.0 days, respectively. The estimated useful life for trailers was 13.6 years, with life expectancy decreasing slightly as days used per year increased.

Depreciation was the largest cost item for the 1-bale, 2-wheel and 4-wheel, and the 2-bale, 4-wheel trailers. These trailers were used a relatively small number of days per year; therefore, tire costs and repairs were less than depreciation. However, the large (3-bale, 4-wheel) trailers were used considerably more, which tended to increase their tire costs and repairs in relation to depreciation costs. The three major cost items for trailers were depreciation, tires and tubes, and repairs. Other costs were interest and housing.

All sized trailers, except the 3-bale 4-wheel, had higher fixed than variable costs. As indicated in Table 15, the total cost per day of use was $1.49, $1.87, $1.67, and $6.08 for the 1-bale, 2-wheel; 1-bale, 4-wheel; 2-bale, 4-wheel; and 3-bale 4-wheel, respectively. Had all sized trailers been used the 27 days average, the cost per day for the respective sizes would have been $.94, $1.68, $1.92 and $2.27. How-

Table 15. Operating costs and related information for 79 farm trailers in Upland areas, Mississippi, 1949.

Item	Size of Trailer			
	1-bale, 2-wheel	1-bale, 4-wheel	2-bale, 4-wheel	3-bale, 4-wheel
	Dollars per trailer			
Variable costs:				
Repairs	6.75	10.18	11.07	12.15
Tires and tubes	4.04	11.42	14.62	19.55
Total	10.79	21.60	25.69	31.70
Variable cost per day	.63	.89	.83	.56
Fixed costs: (1)				
Housing	3.25	5.25	5.25	5.25
Interest	3.38	5.09	5.54	6.08
Depreciation	8.10	13.42	15.33	18.22
Total	14.73	23.76	26.12	29.55
Fixed costs per day	.86	.98	.84	.52
Total costs	25.52	45.36	51.81	61.25
Total costs per day	1.49	1.87	1.67	1.08
	Average per trailer			
1949 purchase price, dollars	135.00	203.57	221.43	243.00
Days used per year	17.2	24.3	31.1	57.0
Estimated life, years	15.0	13.5	13.0	12.0
Age of trailer, years	4.4	3.2	3.3	3.8
No. of trailers	16	35	23	5

(1) Interest and depreciation are computed in the same manner as in Table 12.

ever, since all sized trailers do not have the same capacity, and since data are not available on the percent capacity used each day and other such factors, there is a limit to the comparability of the data.

Combines

The annual use, cost of operation, and related information for 25 combines on Upland farms are shown in Table 16. Combines in the Upland areas, which generally have 4-, 5-, or 6-foot cutting blades, were tractor drawn, and were operated either by power take-off or auxiliary motor.

The principal crops harvested by the combines on farms surveyed were oats, lespedeza and cover crops. There was some combining of other crops reported, such as soybeans, grass seeds, grain sorghums, white clover and other clovers.

According to Table 16, combines were used an average of 9.5 ten-hour days. However, there was a range from 6.8 days to 12.1 days of use. The 4- and 5-foot combines operated by power take-off averaged cutting 6.8 and 9.0 acres per day, respectively. The 5- and 6-foot combines operated by auxiliary motor, combined an average of 9.5 and 10.3 acres per day, respectively. Auxiliary motor operate combines required about 11 gallons of gasoline and .7 quart of oil per day of use. The estimated useful life of combines averaged 9.7 years.

Cost of operating. Data in Table 16 indicate much higher variable costs where auxiliary-motor operated combines were used. These data are not directly comparable, however, since tractor costs (which are not shown) are higher where the power take-off machine is used. Repair was the most significant variable cost for all combines.

Depreciation, constituting 59 percent of total cost of operating combines, was by far the largest item of expense. Fixed costs represented 80 percent of the total cost of operating combines in the survey. For that reason, the high per day and per acre cost of operating combines can be reduced by using the machines more nearly to capacity.

The average total cost for operating combines was $2.43 per acre. This varied from averages of $2.51 and $2.12 per acre for the 4- and 5-foot power take-off machines to $2.36 and $3.56 for the 5- and 6-foot

Table 16. Annual use, cost of operating and related information for 25 combines on farms, Upland areas, Mississippi, 1949.

Item	Unit	Width of cut			
		4-foot	5-foot		6-foot
		Operated by power take-off	Operated by power take-off	Operated by auxiliary motor	Operated by auxiliary motor
		Average per combine			
Annual use:					
10-hr. days used	Number	9.2	8.9	12.1	6.8
Acres harvested	Acres	63	80	115	70
Farms harvesting:					
Oats	Number	4	9	5	3
Lespedeza	Number	3	5	3	2
Other clover seed	Number	3	5	2	1
Soybeans	Number	2	2	2	1
Cover crops	Number	3	5	3	3
Grass seeds	Number	3	6	4	1
Other crops	Number	3	3	2	---
Acres cut per day	Acres	6.8	9.0	9.5	10.3
Gasoline used per day	Gallons	---	---	10.5	11.5
Oil used per day	Quarts	---	---	.7	.7
Est. life of combines	Years	9.7	9.7	9.0	10.7
Age of combines	Years	7.0	4.7	5.5	3.0
Purchase price, 1949	Dollars	1,050	1,119	1,532	1,730
Cost of operating:					
Variable cost:					
Gasoline	Dollars	---	---	29.34	18.02
Oil	Dollars		---	1.94	1.09
Repairs	Dollars	26.50	30.00	41.00	33.00
Total	Dollars	26.50	30.00	72.28	52.11
Variable cost per acre	Dollars	.42	.38	.63	.74
Variable cost per 10-hr. day	Dollars	2.88	3.37	5.97	7.66
Fixed cost:					
Housing	Dollars	8.17	8.17	8.17	8.17
Interest	Dollars	26.25	27.98	38.30	43.25
Depreciation	Dollars	97.42	103.81	153.22	145.51
Total	Dollars	131.84	139.96	199.69	196.93
Fixed cost per acre	Dollars	2.09	1.75	1.74	2.81
Fixed cost per 10-hr. day	Dollars	14.33	15.73	16.50	28.96
Total cost	Dollars	158.34	169.96	271.97	249.04
Total cost per acre	Dollars	2.51	2.12	2.36	3.56
Total cost per 10-hr. day	Dollars	17.21	19.10	22.48	36.62
No. of combines		5	11	6	3

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(1) Gasoline and oil prices same as Table 12; interest and depreciation computed in same manner as in Table 12.

auxiliary-motor powered machines, respectively. The cost of operating the motor and the difference in purchase price account for a major part of the extra cost associated with auxiliary-motor operated combines. Operation of a power take-off combine is classified as heavy work for tractors, while very little power is required for pulling the auxiliary-motor operated combine. If tractor costs were included. no doubt the cost differential between power take-off and auxiliary motor operated combines would be much less.

Hay Balers, Pick-Up

Pick-up hay balers included in the study were used an average of 10.4 ten-hour days, at a performance rate of 10 acres per day, Table 17. Estimated useful life for pick-up balers was 7 years.

Depreciation represented 68 percent of total operating costs of pick-up hay balers. Interest, another fixed cost item, comprised 13 percent of the total costs. According to Table 19, fixed costs accounted for 84 percent of total operating expenses. The only variable cost item was repairs.

The total annual operating cost was $326. Cost per ten-hour day used and per acre amounted to $31.35 and $3.13, respectively, Table 18.

Hay Balers, Stationary

As shown in Table 17, stationary hay balers were used an average of 5.3 ten-hour days on 46.6 acres

Table 17. Performance and related data for hay balers, corn pickers, binders, hammer mills, and ensilage cutters, Upland areas, Mississippi, 1949.

Type and size of equipment	Annual use: Acres OOE	Annual use: Days used	Acres per 10-hour day (1)	Hours per acre
	Acres	Days	Acres	Hours
Hay baler:				
Pick-up	104.0	10.4	10.0	1.0
Stationary	46.6	5.3	8.8	1.1
Corn picker:				
1-row	63.0	10.0	6.3	1.6
2-row	110.0	10.0	11.0	.9
Binder, 1-row	17.5	5.2	3.4	2.9
Hammer mill, medium	xx	2.0	xx	xx
Ensilage cutter, medium	xx	10.0	xx	xx

(1) Not necessarily capacity for 10-hour day, but the amount farmers reported per day.

Table 18. Total and per unit cost of operating hay balers, corn pickers binders, hammer mills, and ensilage cutters, Upland areas, Mississippi, 1949.

Type and size of equipment	Total annual operating cost	Cost per 10-hour day	Cost per hour	Cost per acre
	Dollars	Dollars	Dollars	Dollars
Hay baler:				
Pick-up	326.00	31.35	3.14	3.13
Stationary	54.10	10.21	1.02	1.16
Corn Picker:				
1-row	144.34	14.43	1.44	2.29
2-row	201.23	20.12	2.01	1.83
Binder, 1-row	76.38	14.69	1.47	4.36
Hammer mill, medium	24.50	12.25	1.22	xx
Ensilage cutter, medium	76.50	7.65	.76	xx

of hay. The average estimated useful life of these balers was 16.7 years, Table 19.

Fixed costs for stationary hay balers accounted for 76 percent of total annual operating costs. The variable cost (annual repairs) represented the other 24 percent, or $12.84.

Total annual operating costs for stationary hay balers were $54.10, with a cost of $10.21 per ten-hour day of use, and $1.16 per acre of hay baled, Table 18.

Corn Pickers

One-row corn pickers studied were used an average of 10 ten-hour days and on 63 acres of corn, Table 17. The estimated useful life on the 1-row corn picker was 8 years.

Fixed costs, such as depreciation, interest, and housing, comprised 83 percent of annual operating costs. Variable cost (repairs), accounted for the balance, Table 19.

Total annual operating cost for 1-row corn pickers was $144.34. For each ten-hour day of use and each acre of corn picked, the cost was $14.43 and $2.29, respectively, Table 19.

Two-row corn pickers were used the same number (10) of ten-hour days as the 1-row, but were used on 110 acres of corn, Table 17. According to Table 19, the 2-row corn picker had an estimated useful life of 7.5 years.

Two-row corn pickers included in this study had a fixed cost per year of $168.02, which represented 83 percent of annual operating expenses. As shown in Table 18 the total operating cost for the 2-row corn picker was $201.23. Operating expenses per ten-hour day were $20.12, and per acre of corn picked, $1.83, Table 18.

One-Row Binders

According to Table 17, the 1-row binder was used 5.2 ten-hour days on 17.5 acres of land. The estimated useful life was 10 years.

Fixed cost accounted for 81 percent of the total annual operating cost of $76.38. The 1-row binder cost $14.69 per ten-hour day used and $4.36 per acre covered, Table 18.

Hammer Mills

Hammer mills included in this study were used an average of 20 hours. Estimated useful life was 18 years.

Total annual operating costs of $24.50 were composed of fixed costs, 76 percent, and variable costs, 14 percent. The cost of operating the hammer mills amounted to $1.22 per hour, Table 18.

Ensilage Cutters

Ensilage cutters included in this study were of medium size, and were used an average of 10 ten-hour days. The estimated useful life was 15 years, Table 19.

Fixed costs comprised 76 percent of the annual operating expenses of ensilage cutters. The annual total cost was $76.50. Cost of operating per day amounted to $7.65, Table 18.

Table 19. **Itemized operating costs and related data for hay balers, corn pickers, binders, hammer mills, and ensilage cutters, Upland areas, Mississippi, 1949.**

Type and size of equipment	Present age	Est. life	Purchase price, 1949	Annual depreciation	Interest on investment	Annual repair	Cost of housing	Annual total costs (1)
	Years	Years	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Hay baler:								
Pick-up	2.0	7.0	1735	223.07	43.38	52.05	7.50	326.00
Stationary	7.9	16.7	428	23.06	10.70	12.84	7.50	54.10
Corn picker:								
1-row	4.0	8.0	817	91.91	20.42	24.51	7.50	144.34
2-row	1.5	7.5	1107	132.84	27.68	33.21	7.50	201.23
Binder:								
1-row	4.0	10.0	475	42.75	11.88	14.25	7.50	76.38
Hammer mill	12.0	18.0	200	10.00	5.00	6.00	3.50	24.50
Ensilage cutter	5.0	15.0	600	36.00	15.00	18.00	7.50	76.50

(1) Interest and depreciation calculated on same basis as in Table 12. Annual repairs is 3 percent of purchase price on items where sufficient data were not available. Housing cost is the average cost of those reported.

ANNUAL USE AND COST OF OPERATING AUXILIARY TRACTOR-DRAWN EQUIPMENT

Data for use, performance, and cost of operating auxiliary tractor-drawn equipment were obtained in the summer of 1950 for the crop year of 1949. These data were gathered to supplement and complete data on the so-called "minor" items of machinery and equipment used on mechanized farms.

Itemized annual operating costs are shown in Table 21. Annual depreciation, in all cases, constituted the largest item of cost, ranging from 51 percent of the annual cost on some machines to 71 percent for others. Depreciation accounted for more than 60 percent of annual cost on 69 percent of the machines. Interest on investment and repairs were the other highly significant cost items. Depreciation and interest were calculated in the same manner as in Table 12.

In this chapter some of the usual implements for preparing land, planting, fertilizing, and cultivating are analyzed as to physical use and costs.

Land Preparation Implements

One of the most common land preparation tractor-drawn implements **is the boldboard plow.** Moldboard plows included in this study were used 5.8 ten-hour days on 23.1 acres of land, Table 20. The estimated useful life of these plows was 10.8 years. Two-plow breakers were used 8.3 ten-hour days on 60.3 acres of land, and had an estimated life of 10.6 years.

Fixed costs represent 78 percent of total costs for both the 1- and 2-plow breakers. The total annual operating costs (for the 1- and 2-plow breakers) were $10.79 and $28.54, respectively. Costs per day of use and per acre covered were $1.86 and $.47, respectively, for the 1-plow breaker. The 2-plow breaker cost $3.44 per day and $.47 per acre to operate.

The disc harrow, sized by width in feet, is another very common land preparation machine. The 5-foot disc harrow was used 6.1 days on 65.4 acres of land once over equivalent, while the 6-foot disc harrow was used 7.3 days on 119.6 acres of land. The estimated useful life of the 5- and 6-foot disc harrows was 10.0 and 9.6 years, respectively.

Total annual operating cost for the 5-foot disc harrow was $28.28, 79 percent of which was fixed. Operating cost per ten-hour day and per acre covered was $4.64 and $.43, respectively. Eighty percent of the annual operating costs of the 6-foot disc harrow was represented by fixed cost. The 6-foot disc harrow cost $5.18 for each ten-hour day used and $.32 for each acre disced.

The 3-row section harrows included in this study were used 2.0 ten-hour days on 51.7 acres of land. Estimated useful life of these harrows was 13.5 years, Table 21.

Total annual operating cost for 3-row harrows was $9.25, of which fixed cost accounted for 75 percent. Costs per ten-hour day of use and per acre covered were $4.62 and $.18, respectively, for the 3-row section harrows.

Table 20. Performance and related data for selected tractor machinery and equipment on 88 farms, Upland areas, Mississippi, 1950.

Type and size of equipment	Annual use		Acres per 10-hour ~~Hours~~ Day	Hours per acre
	Acres OOE	Days used		
	Acres	Days	Acres	Hours
Stalk cutter (rolling type):				
1-row	19.0	1.5	12.3	.8
2-row	52.5	2.1	25.0	.4
Breaking plow:				
Moldboard:				
1-plow	23.1	5.8	4.0	2.5
2-plow	60.3	8.3	7.3	1.4
3-plow	90.0	11.2	8.0	1.2
Disc:				
1-disc	27.4	7.2	3.8	2.6
2-disc	84.2	14.0	6.0	1.7
Sulky	56.4	7.4	7.6	1.3
Disc:				
Bush and bog (lap cut):				
4-foot	44.4	8.9	5.0	2.0
5-foot	68.3	10.8	6.3	1.6
6-foot	105.3	13.2	8.0	1.2
7-foot	167.3	15.6	10.7	.9
Harrow:				
4-foot	32.5	4.3	7.5	1.3
5-foot	65.4	6.1	10.7	.9
6-foot	119.6	7.3	16.3	.6
7-foot	60.5	3.1	19.7	.5
Middle-buster:				
1-row	28.7	3.2	9.0	1.1
2-row	68.1	4.1	16.5	.6
Section harrow:				
2-row	36.4	1.9	19.5	.5
3-row	51.7	2.0	26.5	.4
4-row	105.2	2.9	36.7	.3
Planter:				
1-row	24.6	3.0	8.1	1.2
2-row	81.0	4.7	17.2	~~1.2~~ .6
Planter and fertilizer comb:				
1-row	36.6	4.7	7.8	1.3
2-row	77.7	4.9	16.0	.6
Fertilizer distributor:				
2-row	90.5	5.6	16.1	.6
Cultivator:				
1-row	135.9	16.0	8.5	1.2
2-row	397.8	24.7	16.1	.6
Mower:				
4½-foot	40.0	3.5	11.3	.9
5-foot	102.6	7.6	13.5	.7
6-foot	68.9	4.1	16.7	.6
7-foot	170.7	8.8	19.5	.5
Hay rake:				
Dump, 10-foot	50.0	2.0	25.0	.4
Side-delivery, 9-foot	128.0	4.3	30.0	.3
Bull rake:				
8-foot	58.0	2.9	20.0	.5
10-foot	170.0	7.1	24.0	.4
Grain drill:				
8-foot	50.0	3.0	16.7	.6
12-foot	60.0	2.1	28.6	.3
Lime spreader:				
10-foot	102.0	4.0	25.5	.4
12-foot	87.0	2.8	31.5	.3
Cyclone	29.0	1.9	15.0	.7
Poison machine:				
Dust:				
4-row	190.0	6.3	30.0	.3
6-row	327.0	8.4	39.0	.3
Spray:				
4-row	420.0	12.7	33.0	.3
Bug catcher:				
2-row	180.00	7.2	25.0	.4

Table 21. Itemized operating costs and related data for selected tractor machinery and equipment on 88 farms, Upland areas, Mississippi, 1950.

Type and size of equipment	Present age	Est. life	Purchase price, 1950 (1)	Annual depre- ciation	Interest on in- vestment	Annual repairs (2)	Annual total costs
	Years	Years	Dollars	Dollars	Dollars	Dollars	Dollars
Stalk cutter (rolling type):							
1-row	4.0	10.0	65	5.85	1.62	1.25	8.72
2-row	5.0	11.7	110	8.46	2.75	2.30	13.51
Breaking plow:							
Moldboard:							
1-plow	2.7	10.8	78	6.50	1.95	2.34	10.79
2-plow	4.3	10.6	204	17.32	5.10	6.12	28.54
3-plow	3.0	12.0	329	24.68	8.22	9.87	42.77
Disc:							
1-disc	1.8	10.1	133	11.85	3.32	2.00	17.17
2-disc	3.8	11.9	230	17.39	5.75	6.00	29.14
Sulky	2.4	12.0	388	29.10	9.70	9.00	47.80
Disc:							
Bush and bog:							
4-foot	1.7	9.7	110	10.21	2.75	3.30	16.26
5-foot	3.9	13.9	189	12.24	4.72	5.67	22.63
6-foot	3.0	10.4	235	20.34	5.88	7.05	33.27
7-foot	2.0	10.5	272	23.31	6.80	8.16	38.27
Harrow:							
4-foot	1.7	10.5	125	10.71	3.12	3.75	17.58
5-foot	4.0	10.0	195	17.55	4.88	5.85	28.28
6-foot	4.9	9.6	254	23.81	6.35	7.62	37.78
7-foot	5.9	10.3	338	29.53	8.45	10.14	48.12
Middle-buster:							
1-row	3.3	12.8	78	5.48	1.95	2.34	9.77
2-row	4.6	11.8	186	14.19	4.65	5.58	24.42
Section harrow:							
2-row	10.2	15.0	47	2.82	1.18	1.41	5.41
3-row	8.2	13.5	76	5.07	1.90	2.28	9.25
4-row	4.8	8.5	108	11.44	2.70	3.24	17.38
Planter:							
1-row	5.1	10.0	92	8.28	2.30	2.76	13.34
2-row	7.0	10.0	172	15.48	4.30	5.16	24.94
Planter and fertilizer comb:							
1-row	1.6	9.9	130	11.82	3.25	2.75	17.82
2-row	2.6	8.9	225	22.75	5.62	6.92	35.29
Fertilizer distributor:							
2-row	5.0	7.5	67	8.04	1.68	4.00	13.72
Cultivator:							
1-row	2.8	10.4	89	7.70	2.22	6.23	16.15
2-row	2.8	9.7	225	20.88	5.62	12.75	39.25

Table 21 (Continued)

Type and size of equipment	Present age	Est. life	Purchase price, 1950 (1)	Annual depre-ciation	Interest on in-vestment	Annual repairs (2)	Annual total costs
	Years	Years	Dollars	Dollars	Dollars	Dollars	Dollars
Mower:							
4 1/2-foot	6.5	11.0	101	8.26	2.52	5.50	16.28
5-foot	5.2	8.9	237	23.97	5.92	7.11	37.00
6-foot	4.3	10.5	255	21.86	6.38	7.65	35.89
7-foot	4.7	9.1	271	26.80	6.78	8.13	41.71
Hay rake:							
Dump, 10-foot	8.0	12.0	105	7.88	2.62	3.15	13.65
Side-delivery, 9-foot	2.0	10.0	260	23.40	6.50	7.80	37.70
Bull rake:							
8-foot	3.0	10.0	100	9.00	2.50	5.00	16.50
10-foot	4.0	8.0	114	12.82	2.85	7.00	22.67
Grain drill:							
8-foot	1.2	13.5	350	23.33	8.75	6.00	38.08
10-foot	2.0	12.0	480	36.00	12.00	7.50	55.50
Lime spreader:							
10-foot	3.0	10.5	235	20.14	5.88	5.00	31.02
12-foot	1.6	10.0	300	27.00	7.50	6.00	40.50
Cyclone	1.5	13.5	80	5.33	2.00	1.95	9.28
Poison machine:							
Dust:							
4-row	.6	9.0	115	11.50	2.88	3.45	17.83
6-row	1.3	9.3	165	15.97	4.12	4.95	25.04
Spray,							
4-row	.6	12.0	188	14.10	4.70	5.64	24.44
Bug catcher,							
2-row	4.0	10.0	345	31.05	8.62	10.35	50.02

1 — Based on data obtained from 16 implement dealers in Upland areas, Mississippi, 1950.
2 — Based on data obtained from farmers when available; when sufficient data were not available, 3 percent of purchase price was used. This represented an average of those reporting, but may be inaccurate for any specific implement.

Table 22. Total and per unit cost of operating selected tractor equipment, Upland areas, Mississippi, 1950.

Type and size of equipment	Total annual operating cost	Cost per 10-hour day	Cost per hour	Cost per acre (1)
	Dollars	Dollars	Dollars	Dollars
Stalk cutter (rolling type):				
1-row	8.72	5.81	.58	.46
2-row	13.51	6.43	.64	.26
Breaking plow:				
Moldboard:				
1-plow	10.79	1.86	.19	.47
2-plow	28.54	3.44	.34	.47
3-plow	42.77	3.82	.38	.48
Disc:				
1-disc	17.17	2.38	.24	.63
2-disc	29.14	2.08	.21	.35
Sulky	47.80	6.46	.65	.85
Disc:				
Bush and bog:				
4-foot	16.26	1.83	.18	.37
5-foot	22.63	2.10	.21	.33
6-foot	33.27	2.52	.25	.32
7-foot	38.27	2.45	.24	.23
Harrow:				
4-foot	17.58	4.09	.41	.54
5-foot	28.28	4.64	.46	.43
6-foot	37.78	5.18	.52	.32
7-foot	48.12	15.52	1.55	.80
Middle-buster:				
1-row	9.77	3.05	.30	.34
2-row	24.42	5.96	.60	.36
Section harrow:				
2-row	5.41	2.85	.28	.15
3-row	9.25	4.62	.46	.18
4-row	17.38	5.99	.60	.16
Planter:				
1-row	13.34	4.45	.44	.54
2-row	24.94	5.31	.53	.31
Planter and fertilizer comb.:				
1-row	17.82	3.79	.38	.49
2-row	35.29	7.20	.72	.45
Fertilizer distributor,				
2-row	13.72	2.45	.24	.15
Cultivator:				
1-row	16.15	1.01	.10	.12
2-row	39.25	1.60	.16	.10
Mower:				
4½-foot	16.28	4.65	.46	.41
5-foot	37.00	4.87	.49	.36
6-foot	35.89	8.75	.88	.52
7-foot	41.71	4.74	.47	.24
Hay rake:				
Dump, 10-foot	13.65	6.82	.68	.27
Side-delivery, 9-foot	37.70	8.77	.88	.29
Bull rake:				
8-foot	16.50	6.69	.67	.28
10-foot	22.67	3.19	.32	.13
Grain drill:				
8-foot	38.08	12.69	1.27	.76
12-foot	55.50	26.43	2.64	.92
Lime spreader:				
10-foot	31.02	7.76	.78	.30
12-foot	40.50	14 46	1.45	.46
Cyclone	9.28	4.88	.49	.32
Poison machine:				
Dust:				
4-row	17.83	2.83	.28	.09
6-row	25.04	2.98	.30	.08
Spray,				
4-row	24.44	1.92	.19	.06
Bug catcher,				
2-row	50.00	6.95	.70	.28

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[1] —Once-over equivalent.

Planting and Fertilizing Implements

The planter and fertilizer distributor were often bought as one unit by Upland farmers, and likewise used to plant and fertilize in one operation. For this reason, cost analysis was made on them as a single operation.

The 1-row machine (planter and fertilizer combination) was used 4.7 ten-hour days on 36.6 acres of land. These machines had an estimated useful life of 9.9 years. The annual operating expense of the 1-row planter and fertilizer combination was $13.34, 79 percent of which was fixed cost. The expense of operating the 1-row machine per ten-hour day of use was $3.79, and per acre covered $.49.

The 2-row planter and fertilizer combination was used an average of 4.9 ten-hour days on 77.7 acres. Estimated useful life was 8.9 years, and the total annual operating cost was $35.29. The cost per ten-hour day used and per acre covered amounted to $7.20 and $.45, respectively.

Cultivating Implements

One-row cultivator attachments included in this study were used 16.0 ten-hour days on 135.9 acres, once-over equivalent. These implements had an estimated life of 10.4 years. Annual operating cost was $16.15. Cost per ten-hour day of use was $1.01, and per acre covered, $.12, Table 22.

Two-row cultivators were used an average of 24.7 ten-hour days on 397.8 acres, once-over equivalent. These cultivators were estimated to have a useful life of 9.7 years. Of the total annual operating cost ($39.25), 68 percent was fixed cost. The cost of operating the 2-row cultivators in this study was $1.60 and $.10 per ten-hour day and per acre, respectively, (Table 22).

Annual use and performance rates for selected tractor machinery and equipment are shown in Table 20. Itemized operating costs and related data are shown in Table 21. Total and per unit cost of operating selected tractor equipment are shown in Table 22.

Depreciation is the only fixed cost which will tend to vary with use. Therefore, increasing annual use of auxiliary tractor-drawn equipment has the effect of reducing the daily fixed costs and, consequently, total daily costs.

SUMMARY AND CONCLUSIONS

The replacement of workstock by tractors as a source of farm power has initiated many new farm problems. This study was made in order to get a better understanding of these problems. To do this, it was necessary to ascertain the extent to which mechanical power and equipment was being used, and the cost of operating such power and equipment.

Utilization

Tractors were used an average of 54.9 ten-hour days, while workstock were used an average of 38.7 ten-hour days per farm (computed from Table 9.) These data indicate possibilities of considerably more use available for tractor power, if workstock were sold. With some additional use of tractors, unit costs can be reduced substantially.

Other possibilities for increases in the use of tractors and equipment are to practice custom work for other farmers, and increase size of operation by renting or buying more land. Cooperative ownership of specialized equipment, such as combines, hay balers, corn pickers, binders, etc., has provided another means of distributing cost over more days and acres.

Cost of Operation

The average annual cost of operating the very small, small, medium, and large tractors was $235, $337, $475, and $601, respectively. These data indicate that it is more economical to operate the smaller of the 1-and 2-row tractors. However, cost data, as computed in this study, are not directly comparable due to variations in use, life, etc. Further analysis must be made in order to determine the most economical and efficient farm power and equipment for Upland farms.

Fixed cost constituted from 50 to 90 percent of the cost of operating "major" and "minor" farm machinery. Therefore, possibilities for decreasing daily costs are available through increased use of these items. For example, the 5-foot auxiliary - motor - operated combines cost an average of $2.36 per acre, with fixed cost comprising 74 percent of this amount. These combines were used an average of 12.1 ten-hour days on 115 acres. With a 100 percent increase in use of these combines, fixed cost would decrease to approximately 58 percent of total costs. Of course, some costs generally classified as fixed (especially depreciation) might increase somewhat with use but not directly as would most variable costs. The possibilities for increasing the efficiency and lowering the unit cost of operating mechanical equipment are considerable and should be explored continuously on the farm.

Some Effects of Farm Mechanization

According to Upland farmers contacted, there have been numerous changes made on their farms since purchasing mechanical power. Tractors had been on the farms an average of 4.7 years. The average number of workstock per operating unit declined 38 percent while total acres operated increased 14 percent during that time, Table 23. The acreage in crops and pastures increased 17 and 5 percent, respectively.

One-third of all farmers interviewed reported some enlargement in field size and change in row layout since purchasing mechanical power. Thirty-two percent reported changes in drainage patterns, such as making new ditches and straightening old ones. Some other physical changes, such as moving tenant houses or other buildings, were made by 10 percent of the farmers. These changes were made in order to increase field size and lengthen rows.

About 44 percent of the farmers reported plans for adjustments in farming system in the near future. Decreased cotton acreage, increased feed crops acreage, and increased cattle production were the significant changes anticipated. Forty percent of the farmers planned to purchase additional equipment and a few farmers planned to buy additional tractors.

Table 23. Number of farms, tractors, and miscellaneous information by number and size of tractor, Upland areas, Mississippi, 1949.

Item	Number of tractors						Av. per op. unit
	One				More than one		
	Very small	Small	Medium	Large	Medium only	Multi-size	
No. of farms	37	37	80	2	8	14	**XX**
No. of tractors	37	37	80	2	18	35	1.2
No. of males over 16 years old, per farm	1.4	1.9	2.6	3.0	7.5	8.5	2.9
Miles from nearest farm with tractor	.3	.5	.4	.2	.3	.3	.4
No. of years tractors on farms	2.0	2.6	4.6	22.0	14.2	10.5	4.7
No. of farmers, who are farming their first year	6	2	—	—	—	3	.06
Prior to purchase of tractor:							
No. of workstock per farm	2.6	3.3	5.0	5.0	12.2	15.0	5.3
No. of acres operated	111.7	129.8	184.6	210.0	418.5	553.3	197.9
No. of acres in crops	31.4	48.9	73.0	88.5	243.5	251.0	81.2
No. of acres in pasture	29.0	39.8	45.2	70.0	98.8	184.8	85.1
Present:							
No. of workstock	1.2	2.0	3.5	3.0	7.2	3.9	3.3
No. of acres operated	113.2	134.5	207.0	236.5	609.5	656.8	226.2
No. of acres in crops	38.4	52.1	80.3	116.0	311.6	311.1	94.7
No. of acres in pasture	46.1	62.4	80.9	105.0	207.4	253.0	89.2
Changes since purchasing tractor power:							
Field size, % of farms	22	38	34	50	38	36	33
Drainage pattern, % of farms	22	35	35	—	12	50	32
Other physical changes, % of farms	11	8	5	—	25	28	10
Further changes in farming system, % of farms	32	35	56	50	50	28	44
Plans for future purchases:							
Additional equipment, % of farms	54	49	34	—	25	36	40
Additional tractors, by size:							
Very small, % of farms	—	—	—	—	—	—	---
Small, % of farms	—	—	1	—	25	—	6
Medium, % of farms	3	3	8	—	12	14	6
Large, % of farms	—	—	—	—	12	7	1
Planned time of purchases:							
Near future, % purchasers	71	58	74	—	100	100	73
Indefinite, % purchasers	29	42	26	—	—	—	27

Table 24. Tractor sales of 21 implement dealers in five counties of the Upland areas, by size of tractor, for specified periods.

Period	Size of tractor-1								Tractors	
	Very small		Small		Medium		Large		Av. per dealer rep't	Total number
	No. of tractors	% of total	No. of tractors	% of total	No. of tractors	% of total	No. of tractors	% of total		
	Average annual sales									
Prewar (1938-41)	—	—	5	10	39	80	5	10	4.5	49
During war (1942-45)	—	—	7	14	41	81	3	5	3.0	51
Postwar (1946-48)	13	6	33	16	144	69	18	9	5.9	208
1949	65	17	28	8	254	68	26	7	9.6	373
No. of dealers reporting	10		13		19		11			21
Total tractor sales 1938-49-2	119	7	201	12	1 175	68	237	13	82.5	1,732

1—For classification of tractors see Table 4.

2—Average annual tractor sales are not equal to the total sales 1938-1949. Some dealers were unable to supply information by specified periods, but did give total sales by size of tractor.

Changes in the land-use pattern, field size, row layout, drainage patterns, etc., are prerequisite to successful adaptation of tractors to many hill sections. Such changes permit more efficiency in the use of mechanical power, and should be investigated very closely. Research can best do this through case analysis.

Trends

In order to gain some additional insight into consumer preferences and to learn more of the trend in these preferences, information on tractor sales was secured from implement dealers in the area, Table 24. The medium tractor was by far the most popular throughout the period 1938 through 1949. However, in proportion of total tractor sales, the medium tractor was declining in importance, largely because of the introduction of smaller tractors in recent years.

Large tractors did not vary significantly in proportion of total sales throughout the period. The very small tractors, which were first produced during the early post-war period, have become increasingly important in terms of numbers sold. By 1949, the annual sales of the small tractor were in sharp decline. These data indicate that in 1949 the preference in the Upland section was for very small and medium tractors.

Need for Further Study of Problem

Trend data indicate that farmers are turning to medium and very small tractors. It may be that they have found through trial and error which tractor types are most economical. This is something that needs further study, however, as trial and error is often an expensive and painful process.

It is believed that this study has presented sufficient information for detailed study of the very important and very complex problem introduced by mechanization of farm work in Upland areas. Budgetary analysis, tempered with good judgment, must supply the final answers.

APPENDIX

Table 1. Tenure and land-use organization, by number and size of tractor on 178 farms, Upland areas, Mississippi, 1949.

Item	Number of tractors per farm											
	One								More than one			
	Size of tractor								Size of tractor			
	Very small		Small		Medium		Large		Medium only		Multisize	
	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't
	Acres		Acres		Acres		Acres		Acres		Acres	
Tenure:												
Land owned	26	112.6	27	137.2	71	205.3	2	330.5	7	570.1	14	634.3
Land rented in	17	77.3	14	87.3	27	91.7	—	—	3	295.0	2	197.5
Land rented out	3	17.7	2	45.5	11	44.8	1	188.0	—	—	1	80.0
All land operated	37	113.2	37	134.5	80	207.0	2	236.5	8	609.5	14	656.8
Land use:												
Croplands:	37	38.4	37	52.1	80	80.3	2	116.0	8	311.6	14	311.1
Planted	37	33.2	37	47.6	80	73.1	2	57.5	8	254.1	14	305.7
Idle	8	23.7	12	13.9	27	21.5	1	117.0	3	153.3	4	18.8
Pasture:												
Open permanent	22	24.4	25	27.0	54	47.8	2	80.0	7	148.4	11	210.4
Woodland	27	43.2	28	58.3	59	65.9	1	50.0	4	155.0	9	136.4
Woodland	10	80.0	7	76.8	37	74.8	—	—	4	52.0	8	120.2
Waste land	29	8.8	31	6.5	74	12.1	2	15.5	8	64.5	11	30.4
No. of farms	37	xx	37	xx	80	xx	2	xx	8	xx	14	xx
No. of tractors	37	1.0	37	1.0	80	1.0	2	1.0	18	2.2	35	2.5

Table 2. Cropland organization, by number and size of tractor, on 178 farms, Upland areas, Mississippi, 1949.

Item	Number of tractors per farm											
	One								More than one			
	Size of tractor								Size of tractor			
	Very small		Small		Medium		Large		Medium only		Multisize	
	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't
	Acres		Acres		Acres		Acres		Acres		Acres	
Cotton:												
Operator	32	14.8	35	18.2	64	19.9	1	15.0	7	36.3	10	39.9
Cropper	2	10.0	6	13.8	31	37.6	1	45.0	3	136.3	10	121.7
Corn:												
Operator	35	11.5	34	16.2	74	21.2	2	23.5	8	59.0	9	42.3
Cropper	2	13.5	6	15.5	28	25.5	—	—	2	95.0	10	65.1
Oats:												
Operator	1	4.0	4	10.5	7	18.3	—	—	5	49.4	4	68.0
Cropper	—	—	—	—	—		—	—	—	—	2	30.0
Hay, lespedeza:												
Operator	6	10.1	10	13.2	13	11.7	—	—	5	48.0	5	57.0
Cropper	—	—	2	4.5	2	15.8	—	—	—	—	2	40.0
Hay, other:												
Operator	18	7.5	14	11.6	32	19.9	1	3.0	4	30.5	7	122.9
Cropper	—	—	1	1.5	X.6	2.2	—	—	—	—	3	26.7
Soybeans:												
Operator	3	15.3	—	—	7	18.9	—	—	2	40.0	2	16.0
Cropper	—	—	—	—	1	13.0	—	—	—	—	2	1.5
Truck crops:												
Operator	17	3.0	15	3.6	20	2.9	—	—	4	6.2	4	6.0
Cropper	—	—	1	3.0	4	1.8	—	—	—	—	5	12.0
All other crops:—1												
Operator	4	3.1	3	9.3	8	8.1	1	5.0	2	33.0	2	78.5
Cropper	—	—	—	—	1	3.0	—	—	—	—	1	5.0
No. of farms	37	xx	37	xx	80	xx	2	xx	8	xx	14	xx
No. of tractors	37	1.0	37	1.0	80	1.0	2	1.0	18	2.2	35	2.5

1—Cover crops, grain sorghums, clovers, sudan grass, millet, and sorghum.

Table 3. Livestock organization, by number and size of tractor, on 178 farms, Upland areas, Mississippi, 1949.

Item	Number of tractors per farm											
	One								More than one			
	Size of tractor								Size of tractor			
	Very small		Small		Medium		Large		Medium only		Multisize	
	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't	No. of farms rep't	Av. per farms rep't
Workstock	24	1.9	31	2.4	69	4.0	1	6.0	8	7.2	13	9.6
Cattle:												
Milk cows	33	4.8	33	4.2	73	6.5	2	2.0	8	11.2	13	8.4
Other cattle	26	7.5	31	8.3	72	14.8	1	89.0	6	62.8	11	85.5
Hogs:												
Brood sows	17	1.2	19	1.8	35	2.3	1	1.0	7	3.0	5	4.2
Other hogs	33	3.9	36	6.2	64	10.1	2	6.0	7	21.0	10	13.2
Sheep	—	—	—	—	—	—	—	—	—	—	1	52.0
Goats	—	—	1	50.0	1	50.0	—	—	—	—	—	—
Poultry:												
Hens and pullets	33	63.9	35	79.1	71	73.7	2	30.0	8	197.5	14	76.8
Broilers	—	—	—	—	1	2000.0	—	—	—	—	—	—
Turkeys	1	50.0	2	176.5	—	—	—	—	—	—	—	—
Ducks	1	30.0	—	—	1	10.0	—	—	—	—	—	—
Geese	1	5.0	—	—	—	—	—	—	—	—	—	—
Guineas	1	25.0	—	—	—	—	—	—	—	—	—	—
No. of farms	37	xx	37	xx	80	xx	2	xx	8	xx	14	xx
No. of tractors	37	1.0	37	1.0	80	1.0	2	1.0	18	2.2	35	2.5

Table 4. Summary of utilization of tractors and workstock—1, by size of tractor and operations performed, on 153 farms—2, with only one tractor, Upland areas, Mississippi, 1949.

Operation	Size of tractor											
	Very small			Small			Medium			Large		
	On farm	Custom	Work-stock	On farm	Custom	Work-stock	On farm	Custom	Work-stock	On farm	Custom	Work-stock
	Average per farm (or per tractor)—3.											
Heavy work:												
Disc:												
10-hour days	8.2	.3	—	9.7	.7	*	12.8	.9	—	16.5	4.2	—
Acs. OOE	60.9	3.8	—	111.6	7.4	.1	171.9	11.0	—	261.0	100.0	—
Break:												
10-hour days	4.4	.2	1.0	4.8	*	.3	2.9	.4	1.7	—	—	—
Acs. OOE	15.5	.6	1.6	25.5	.2	.5	27.3	4.2	7.5	—	—	—
Bed:												
10-hour days	2.3	—	.9	1.8	.1	2.0	3.6	.1	2.8	1.0	—	7.5
Acs. OOE	17.6	—	5.7	20.7	2.7	10.6	52.9	1.1	16.9	20.0	—	52.5
Combine, P. T. O.:												
10-hour days	—	—	—	.2	—	—	.3	.1	—	—	—	—
Acs. OOE	—	—	—	.8	—	—	3.0	.9	—	—	—	—
Total heavy work:												
10-hour days	14.9	.5	1.9	16.5	.8	2.3	19.6	1.5	4.5	17.5	4.2	7.5
Acs. OOE	94.0	4.4	7.3	158.6	10.3	11.2	255.1	17.2	24.4	281.0	100.0	52.5
Light work:												
Plant:												
10-hour days	2.2	.1	1.5	1.5	—	4.4	1.2	*	6.2	—	—	13.0
Acs. OOE	16.2	.4	11.3	12.7	—	31.8	18.9	.6	36.6	—	—	115.0
Cultivate:												
10-hour days	14.9	—	3.6	13.6	—	13.0	13.2	*	22.3	.5	—	48.5
Acs. OOE	119.6	—	24.2	127.5	—	80.1	191.5	.2	116.0	12.0	—	239.5
Harrow:												
10-hour days	1.7	—	.2	3.2	—	.9	2.9	*	.8	5.0	—	—
Acs. OOE	29.1	—	2.2	66.2	—	6.9	74.3	.2	8.5	200.0	—	—

((Continued) Table 4. Summary of utilization of tractors and workstock—1, by size of tractor and operations performed, on 153 farms—2 with only one tractor, Upland areas, Mississippi, 1949.

Operation	Size of tractor											
	Very small			Small			Medium			Large		
	On farm	Custom	Work-stock	On farm	Custom	Work-stock	On farm	Custom	Work-stock	On farm	Custom	Work-stock
	Average per farm (or per tractor)—3.											
Mow:												
10-hour days	2.6	.7	.1	.9	*	.4	.9	.4	.5	—	—	—
Acs. OOE	27.4	6.1	.4	9.5	.2	2.8	15.6	5.6	3.7	—	—	—
Fertilize:												
10-hour days	.1	*	.2	.2	—	9	.2	—	1.4	—	—	6.0
Acs. OOE	1.0	.3	1.4	1.6	—	6.1	2.9	—	10.3	—	—	36.0
Belt work:												
10-hour days	2.2	—	—	.7	—	—	2.4	—	—	—	—	—
Haul:												
10-hour days	5.5	*	1.2	8.0	—	1.6	4.7	—	2.7	—	—	—
Other work: —4												
10-hour days	.2	.1	—	.1	—	.4	1.2	.9	.2	—	—	—
Acs. OOE	2.8	1.6	—	.9	—	1.2	10.9	.4	.9	—	—	—
Total light work:												
10-hour days	29.4	.9	6.8	28.2	*	21.6	26.7	1.3	34.1	5.5	—	67.5
Acs. OOE	196.1	8.4	39.5	218.4	.2	128.9	314.1	7.0	176.0	212.0	—	390.5
Total work:												
10-hour days	44.3	1.4	8.7	44.7	.3	23.9	46.3	2.8	38.6	23.0	4.2	75.0
Acs. OOE	290.1	12.8	46.3	377.0	10.5	140.1	569.2	24.2	200.4	493.0	100.0	443.0

*—Less than .05.
1—Workstock on farms by size of tractor: very small-1.2, small-2.1, medium-3.5, large-3.0
2—No. of farms reporting by size of tractor: very small-36, small-37, medium-78 large-2.
3—See Appendix Tables 5-8 for percent of farms reporting and average for those reported.
4—See Appendix Tables 5-8 for composition of "other work".

Table 5. Utilization of very small tractors and workstock, by operations, on 36 farms with only one tractor, Upland areas, Mississippi, 1949.

Operation	Tractors							Workstock (1)		
	On farm work			Custom work			Total use Per VS tractor	On farm work		
	Percent of all units (2) rep't	Average		Percent of all units rep't	Average			Percent of all units rep't	Average	
		Per tractor rep't	All VS tractors		Per tractor rep't	All VS tractors			Per farm rep't	All farms in group
Heavy work:										
Disc:	92			17				0		
10-hour days	~~92~~	8.9	8.2	xx	1.9	.3	8.5	xx	—	—
Acs. OOE	xx	66.4	60.9	xx	22.8	3.8	64.8	xx	—	—
Break:	~~xx~~ 72			8				17		
10-hour days	~~72~~	6.1	4.4	xx	2.0	.2	4.6	xx	6.2	1.0
Acs. OOE	xx	21.5	15.5	xx	7.8	.6	16.2	xx	9.5	1.6
Bed:	~~xx~~ 69			0				17		
10-hour days	~~69~~	3.3	2.3	xx	—	—	2.3	xx	4.6	.9
Acs. OOE	xx	25.4	17.6	xx	—	—	17.6	xx	29.4	5.7
Total heavy work:	~~xx~~									
10-hour days	xx	xx	14.9	xx	xx	.5	15.4	xx	xx	1.9
Acs. OOE	xx	xx	94.0	xx	xx	4.4	98.6	xx	xx	7.3
Light work:										
Plant:	58			3				44		
10-hour days	xx	3.7	2.2	xx	2.0	.1	2.2	xx	3.4	1.5
Acs. OOE	xx	27.7	16.2	xx	15.0	.4	16.6	xx	25.4	11.3
Cultivate:	100			0				33		
10-hour days	xx	14.9	14.9	xx	—	—	14.9	xx	10.7	3.6
Acs. OOE	xx	119.6	119.6	xx	—	—	119.6	xx	72.6	24.2
Harrow:	69			0				6		
10-hour days	xx	2.5	1.7	xx	—	—	1.7	xx	8.0	.2
Acs. OOE	xx	41.9	29.1	xx	—	—	29.1	xx	80.0	2.2

(Continued) **Table 5. Utilization of very small tractors and workstock, by operations, on 36 farms with only one tractor, Upland areas, Mississippi, 1949.**

Operation	Tractors							Workstock (1)		
	On farm work			Custom work			Total use	On farm work		
	Percent of all units rep't	Average		Percent of all units rep't	Average		Per VS tractor	Percent of all units rep't	Average	
		Per tractor rep't	All VS tractors		Per tractor rep't	All VS tractors			Per farm rep't	All farms in group
Mow	53			14				6		
10-hour days	xx	5.0	2.6	xx	4.7	.7	3.3	xx	1.0	.1
Acs. OOE	xx	51.9	27.4	xx	44.2	6.1	33.5	xx	8,0	.4
Fertilize:	6			3				8		
10-hour days	xx	2.5	.1	xx	1.0	*	.2	xx	3.0	.2
Acs. OOE	xx	17.5	1.0	xx	10.0	.3	1.2	xx	17.0	1.4
Belt work:	25			0				0		
10-hour days	xx	9.0	2.2	xx	—	—	2.2	xx	—	—
Haul:	50			3				8		
10-hour days	xx	10.9	5.5	xx	1.0	*	5.5	xx	.2	1.2
Other work: (3)	11			3				0		
10-hour days	xx	1.4	.2	xx	3.0	.1	.3	xx	—	—
Acs. OOE	xx	49.5	2.8	xx	59.0	1.6	4.4	xx	—	—
Total light work:										
10-hour days	xx	xx	29.4	xx	xx	.9	30.3	xx	xx	6.8
Acs. OOE	xx	xx	196.1	xx	xx	8.4	204.5	xx	xx	39.5
Total work:										
10-hour days	xx	xx	44.3	xx	xx	1.4	45.7	xx	xx	8.7
Acs. OOE	xx	xx	290.1	xx	xx	12.8	303.1	xx	xx	46.8

(*) Less than .05.

(1) Sixty-seven percent of farms reported some workstock with an average of 1.2 for all farms.

(2) Units can be interpreted as either farm or tractor (only one tractor per farm).

(3) Other work consisted of building terraces, raking hay, baling hay, cultipacking, and spreading slag.

Table 6. Utilization of small tractors and workstock, by operations, on 37 farms with only one tractor, Upland areas, Mississippi, 1949.

Operation	Tractors							Workstock (1)		
	On farm work			Custom work			Total use Per small tractor	On farm work		
	Percent of all units rep't	Average		Percent of all units rep't	Average			Percent of all units rep't	Average	
		Per tractor rep't	All small tractors		Per tractor rep't	All small tractors			Per farm rep't	All farms in group
Heavy work:										
Disc:	97			16				3		
10-hour days	xx	9.9	9.7	xx	4.0	.7	10.4	xx	1.0	*
Acs. OOE	xx	114.8	111.6	xx	45.7	7.4	119.0	xx	4.0	.1
Break:	59			5				11		
10-hour days	xx	8.1	4.8	xx	.3	*	4.8	xx	3.1	.3
Acs. OOE	xx	42.9	25.5	xx	3.5	.2	25.7	xx	5.0	.5
Bed:	49			3				35		
10-hour days	xx	3.7	1.8	xx	5.0	.1	1.9	xx	5.8	2.0
Acs. OOE	xx	42.5	20.7	xx	100.0	2.7	23.4	xx	30.1	10.6
Combine, P.T.O.:	5			—				—		
10-hour days	xx	2.8	.2	xx	—	—	.2	xx	—	—
Acs. OOE	xx	14.5	.8	xx	—	—	.8	xx	—	—
Total heavy work:										
10-hour days	xx	xx	16.5	xx	xx	.8	17.3	xx	xx	2.3
Acs. OOE	xx	xx	158.6	xx	xx	10.3	168.9	xx	xx	11.2
Light work:										
Plant:	38			—				65		
10-hour days	xx	4.0	1.5	xx	—	—	1.5	xx	6.7	4.4
Acs. OOE	xx	33.8	12.7	xx	—	—	12.7	xx	49.0	31.8
Cultivate:	86			—				57		
10-hour days	xx	15.8	13.6	xx	—	—	13.6	xx	22.9	13.0
Acs. OOE	xx	147.4	127.5	xx	—	—	127.5	xx	141.2	80.1
Harrow:	78			—				11		
10-hour days	xx	4.1	3.2	xx	—	—	3.2	xx	7.9	.9
Acs. OOE	xx	84.5	66.2	xx	—	—	66.2	xx	64.2	6.9

(Continued) Table 6. Utilization of small tractors and workstock, by operations, on 37 farms with only one tractor, Upland areas, Mississippi, 1949.

Operation	Tractors							Workstock (1)		
	On farm work			Custom work			Total use Per small tractor	On farm work		
	Percent of all units rep't	Average		Percent of all units rep't	Average			Percent of all units rep't	Average	
		Per tractor rep't	All small tractors		Per tractor rep't	All small tractors			Per farm rep't	All farms in group
Mow:	30			3				14		
10-hour days	xx	3.0	.9	xx	.8	*	.9	xx	2.9	.4
Acs. OOE	xx	32.1	9.5	xx	8.0	.2	9.7	xx	20.6	2.8
Fertilize: (2)	11			—				16		
10-hour days	xx	1.8	.2	xx	—	—	.2	xx	5.4	.9
Acs. OOE	xx	15.0	1.6	xx	—	—	1.6	xx	37.4	6.1
Belt work:	27			—				—		
10-hour days	xx	2.7	.7	xx	—	—	.7	xx	—	—
Haul:	41			—				14		
10-hour days	xx	19.8	8.0	xx	—	—	8.0	xx	11.6	1.6
All other work: (3)	5			—				5		
10-hour days	xx	1.8	.1	xx	—	—	.1	xx	6.8	.4
Acs. OOE	xx	16.5	.9	xx	—	—	.9	xx	21.5	1.2
Total light work:										
10-hour days	xx	xx	28.2	xx	xx	*	28.2	xx	xx	21.6
Acs. OOE	xx	xx	218.4	xx	xx	.2	218.6	xx	xx	128.9
Total work:										
10-hour days	xx	xx	44.7	xx	xx	.8	45.5	xx	xx	23.9
Acs. OOE	xx	xx	377.0	xx	xx	10.5	387.5	xx	xx	140.1

(*) Less than .05.

(1) Eighty-four percent of farms had workstock with an average of 2.1 for all farms.

(2) Fertilize as a single operation only. Usual practice was to fertilize and plant in one operation. Where such combination was practiced the operation was recorded as planting.

(3) Other work for tractors consisted of raking and baling hay, drilling oats, and listing with disc hillers, while for workstock it represented raking hay, opening rows, and listing with a turning plow.

Table 7. Utilization of medium tractors and workstock, by operations, on 78 farms with only one tractor, Upland areas, Mississippi, 1949.

Operation	Tractor							Workstock (1)		
	On farm work			Custom Work			Total use Per medium tractor	On farm work		
	Percent of all Units rep't	Average		Percent of all Units rep't	Average			Percent of all Units rep't	Average	
		Per tractor rep't	All medium tractor		Per Tractor rep't	All medium Tractors			Per farm rep't	All farm in group
Heavy work:										
Disc:	97			22				—		
10-hour days	xx	13.1	12.8	xx	4.0	.9	13.7	xx	—	—
Acs. OOE	xx	176.4	171.9	xx	50.6	11.0	182.9	xx	—	—
Break:	49			5				10		
10-hour days	xx	5.9	2.9	xx	6.8	.4	3.3	xx	16.3	1.7
Acs. OOE	xx	56.0	27.3	xx	82.0	4.2	31.5	xx	72.9	7.5
Bed:	54			4				31		
10-hour days	xx	6.6	3.6	xx	1.7	.1	3.7	xx	9.1	2.8
Acs. OOE	xx	98.2	52.9	xx	27.7	1.1	54.0	xx	54.9	16.9
Combine, P.T.O.:	10			2				—		
10-hour days	xx	2.5	.3	xx	3.5	.1	.4	xx	—	—
Acs. OOE	xx	29.0	3.0	xx	35.0	.9	3.9	xx	—	—
Total heavy work:										
10-hour days	xx	xx	19.6	xx	xx	1.5	21.1	xx	xx	4.5
Acs. OOE	xx	xx	255.1	xx	xx	17.2	272.3	xx	xx	24.4
Light work:										
Plant:	37			1				58		
10-hour days	xx	3.1	1.2	xx	3.3	*	1.2	xx	10.8	6.2
Acs. OOE	xx	50.8	18.9	xx	50.0	.6	19.5	xx	63.4	36.6
Cultivate:	73			1				60		
10-hour days	xx	18.1	13.2	xx	.8	*	13.2	xx	37.0	22.3
Acs. OOE	xx	262.0	191.5	xx	15.0	.2	191.7	xx	192.5	116.0
Harrow:	69			2				13		
10-hour days	xx	4.2	2.9	xx	.6	*	2.9	xx	5.9	.8
Acs. OOE	xx	107.3	74.3	xx	9.5	.2	74.5	xx	66.4	8.5

(Continued) Table 7. Utilization of medium tractors and workstock, by operations, on 78 farms with only one tractor, Upland areas, Mississippi, 1949.

Operation	Tractor							Workstock (1)		
	On farm work			Custom Work			Total use	On farm work		
	Percent of all Units rep't	Average		Percent of all Units rep't	Average			Percent of all Units rep't	Average	
		Per tractor rep't	All medium tractor		Per Tractor rep't	All medium Tractors	Per medium tractor		Per farm rep't	All farm in group
Mow:	23			5				17		
10-hour days	xx	4.0	.9	xx	7.2	.4	1.3	xx	3.3	.5
Acs. OOE	xx	67.6	15.6	xx	109.5	5.6	21.2	xx	22.1	3.7
Fertilize:	8			—				18		
10-hour days	xx	2.9	.2	xx	—	—	.2	xx	7.9	1.4
Acs. OOE	xx	38.2	2.9	xx	—	—	2.9	xx	57.6	10.3
Beltwork:	15			—				—		
10-hour days	xx	15.6	2.4	xx	—	—	2.4	xx	—	—
Haul:	31			—				18		
10-hour days	xx	15.2	4.7	xx	—	—	4.7	xx	14.8	2.7
Other work: (2)	17			4				6		
10-hour days	xx	7.4	1.2	xx	33.5	.9	2.1	xx	3.3	.2
Acs. OOE	xx	77.3	10.9	xx	16.5	.4	11.3	xx	36.0	.9
Total light work:										
10-hour days	xx	xx	26.7	xx	xx	1.3	28.0	xx	xx	34.1
Acs. OOE	xx	xx	314.1	xx	xx	7.0	321.1	xx	xx	176.0
Total work:										
10-hour days	xx	xx	46.3	xx	xx	2.8	49.1	xx	xx	38.6
Acs. OOE	xx	xx	569.2	xx	xx	24.2	593.4	xx	xx	200.4

(*) Less than .05.
(1) Eighty-six percent of farms reported some workstock with an average of 3.5 for all farms.
(2) Other work for tractors consisted of baling hay pulling side-delivery hay rake, cultipacker, lime spreader, and 1-row binder; for workstock, it consisted of raking hay and garden work.

Table 8. Utilization of large tractors and workstock, by operations, on two farms with only one tractor, Upland areas, Mississippi, 1949.

Operation	Tractor							Workstock (1)		
	On farm work			Custom Work			Total use Per large tractor	On farm work		
	Percent of all Units rep't	Average		Percent of all Units rep't	Average			Percent of all Units rep't	Average	
		Per tractor rep't	All large tractor		Per Tractor rep't	All large Tractors			Per farm rep't	All farm in group
Heavy work:										
Disc:	100			50			—	—		
10-hour days	xx	16.5	16.5	xx	8.3	4.2	20.7	xx	—	—
Acs. OOE	xx	261.0	261.0	xx	200.0	100.0	361.0	xx	—	—
Bed:	50			—				50		
10-hour days	xx	2.0	1.0	xx	—	—	1.0	xx	15.0	7.5
Acs. OOE	xx	40.0	20.0	xx	—	—	20.0	xx	105.0	52.5
Total heavy work:										
10-hour days	xx	xx	17.5	xx	xx	4.2	21.7	xx	xx	7.5
Acs. OOE	xx	xx	281.0	xx	xx	100.0	381.0	xx	xx	52.5
Light work:										
Plant:	—			—				100		
10-hour days	xx	—	—	xx	—	—	—	xx	13.0	13.0
Acs. OOE	xx	—	—	xx	—	—	—	xx	115.0	115.0
Cultivate:	50			—				50		
10-hour days	xx	1.0	.5	xx	—	—	.5	xx	97.0	48.5
Acs. OOE	xx	24.0	12.0	xx	—	—	12.0	xx	479.0	239.5
Harrow:	50			—				—		
10-hour days	xx	10.0	5.0	xx	—	—	5.0	xx	—	—
Acs. OOE	xx	400.0	200.0	xx	—	—	200.0	xx	—	—
Fertilize:	—			—				50		
10-hour days	xx	—	—	xx	—	—	—	xx	12.0	6.0
Acs. OOE	xx	—	—	xx	—	—	—	xx	72.0	36.0
Total light work:										
10-hour days	xx	xx	5.5	xx	xx	—	5.5	xx	xx	67.5
Acs. OOE	xx	xx	212.0	xx	xx	—	212.0	xx	xx	390.5
Total work:										
10-hour days	xx	xx	23.0	xx	xx	4.2	27.2	xx	xx	75.0
Acs. OOE	xx	xx	493.0	xx	xx	100.0	593.0	xx	xx	443.0

(1) One hundred percent of farms reported workstock with an average of 3.0 for all farms.

Table 9. Utilization of 42 very small tractors and workstock, by operations, on 41 farms, Upland areas, Mississippi, 1949.

Operation	Tractors					Workstock (1)		
	Percent of all farms rep't	Percent of all tractors rep't	Average			Percent of all farms rep't	Average	
			Per tractor rep't	All VS tractor	All farms in group		Per farm rep't	All farms in group
Heavy work:								
Disc:	80	78				—		
10-hour days	xx	xx	9.2	7.3	7.4	xx	—	—
Acs. OOE	xx	xx	70.6	55.4	56.8	xx	—	—
Break:	63	62				15		
10-hour days	xx	xx	6.3	3.9	4.0	xx	6.2	.9
Acs. OOE	xx	xx	22.4	13.9	14.2	xx	9.5	1.4
Bed:	63	62				22		
10-hour days	xx	xx	3.4	2.1	2.2	xx	4.3	.9
Acs. OOE	xx	xx	25.6	15.8	16.2	xx	27.6	6.0
Total heavy work:								
10-hour days	xx	xx	xx	13.3	13.6	xx	xx	1.8
Acs. OOE	xx	xx	xx	85.1	87.2	xx	xx	7.4
Light work:								
10-hour days	54	52				46		
Plant:	xx	xx	3.7	2.0	2.0	xx	4.6	2.2
10-hour days	xx	xx	28.0	14.7	15.0	xx	31.5	14.6
Acs. OOE	100	100				34		
Cultivate:	xx	xx	15.2	15.2	15.6	xx	13.0	4.4
Acs. OOE	xx	xx	120.6	120.6	123.5	xx	84.8	28.9
Harrow:	68	67				5		
10-hour days	xx	xx	2.8	1.9	1.9	xx	8.0	.4
Acs. OOE	xx	xx	52.1	34.7	35.5	xx	80.0	3.9
Mow:	51	50				5		
10-hour days	xx	xx	7.4	3.7	3.8	xx	1.0	*
Acs. OOE	xx	xx	80.6	40.3	41.3	xx	8.0	.4

(Continued) Table 9. Utilization of 42 very small tractors and workstock, by operations, on 41 farms, Upland areas, Mississippi, 1949.

Operation	Tractors					Workstock (1)		
	Percent of all farms rep't	Percent of all tractors rep't	Average			Percent of all farms rep't	Average	
			Per tractor rep't	VS tractor	All farms in group		Per farm rep't	All farms in group
Fertilize:	10	11				10		
10-hour days	xx	xx	3.1	.4	.4	xx	6.0	.6
Acs. OOE	xx	xx	24.0	2.9	2.9	xx	35.2	3.4
Belt work:	22	21						
10-hour days	xx	xx	9.0	1.9	2.0	xx	—	—
Haul:		45				7		
10-hour days	xx	xx	10.6	4.8	4.9	xx	15.0	1.1
Other work: (2)	17	17				—		
10-hour days	xx	xx	5.4	.9	.9	xx	—	—
Acs. OOE	xx	xx	142.6	23.8	24.3	xx	—	—
Total light work:								
10-hour days	xx	xx	xx	30.8	31.5	xx	xx	8.7
Acs. OOE	xx	xx	xx	237.0	242.5	xx	xx	51.2
Total work:								
10-hour days	xx	xx	xx	44.1	45.1	xx	xx	10.5
Acs. OOE	xx	xx	xx	322.1	329.7	xx	xx	58.6

(*) Less than .05.

(1) Seventy-one percent of farms reported workstock with an average of 2.2 for all farms.

(2) Other work consisted of building terraces, raking hay, baling hay, cultipacking, and spreadng slag.

Table 10. Utilization of 38 small tractors and workstock, by operations, on 38 farms, Upland areas, Mississippi, 1949.

Operation	Tractors					Workstock (1)		
	Percent of all farms rep't	Percent of all tractors rep't	Average			Percent of all farms rep't	Average	
			Per tractor rep't	All small tractor	All farms in group		Per farm rep't	All farms in group
Heavy work:								
Disc:	95	95				3		
10-hour days	xx	xx	10.6	10.0	10.0	xx	1.0	*
Acs. OOE	xx	xx	117.9	111.7	111.7	xx	4.0	.1
Break:	58	58				10		
10-hour days	xx	xx	8.1	4.7	4.7	xx	3.1	.3
Acs. OOE	xx	xx	43.3	25.0	25.0	xx	5.0	.5
Bed:	47	47				34		
10-hour days	xx	xx	4.0	1.9	1.9	xx	5.8	2.0
Acs. OOE	xx	xx	48.1	22.8	22.8	xx	30.1	10.3
Combine, P.T.O.:	5	5				—		
10-hour days	xx	xx	2.8	.1	.1	xx	—	—
Acs. OOE	xx	xx	14.5	.8	.8	xx	—	—
Total heavy work:								
10-hour days	xx	xx	xx	16.7	16.7	xx	xx	2.3
Acs. OOE	xx	xx	xx	160.3	160.3	xx	xx	10.9
Light work:								
Plant	37	37				66		
10-hour days	xx	xx	4.0	1.5	1.5	xx	7.0	4.6
Acs. OOE	xx	xx	33.5	12.3	12.3	xx	50.6	33.3
Cultivate:	87	87				58		
10-hour days	xx	xx	17.1	14.8	14.8	xx	22.0	12.7
Acs. OOE	xx	xx	152.1	132.1	132.1	xx	135.5	78.4
Harrow:	79	79				10		
10-hour days	xx	xx	4.3	3.4	3.4	xx	7.9	.8
Acs. OOE	xx	xx	91.6	72.4	72.4	xx	64.2	6.8

(Continued) Table 10. Utilization of 38 small tractors and workstock, by operations, on 38 farms, Upland areas, Mississippi, 1949.

Operation	Tractors					Workstock (1)		
	Percent of all farms rep't	Percent of all tractors rep't	Average			Percent of all farms rep't	Average	
			Per tractor rep't	All small tractor	All farms in group		Per farm rep't	All farms in group
Mow:	29	29				13		
10-hour days	xx	xx	3.1	.9	.9	xx	2.9	.4
Acs. OOE	xx	xx	32.8	9.5	9.5	xx	20.6	2.7
Fertilize:	10	10				16		
10-hour days	xx	xx	1.8	.2	.2	xx	5.4	.9
Acs. OOE	xx	xx	15.0	1.6	1.6	xx	37.4	5.9
Belt work:	26	26				—		
10-hour days	xx	xx	2.7	.7	.7	xx	—	—
Haul:	42	42				13		
10-hour days	xx	xx	24.8	10.4	10.4	xx	11.6	1.5
Other work: (2)	8	8				5		
10-hour days	xx	xx	10.9	.9	.9	xx	6.8	.4
Acs. OOE	xx	xx	298.3	23.6	23.6	xx	21.5	1.1
Total light work:								
10-hour days	xx	xx	xx	32.8	32.8	xx	xx	21.3
Acs. OOE	xx	xx	xx	251.5	251.5	xx	xx	128.2
Total work:								
10-hour days	xx	xx	xx	49.5	49.5	xx	xx	23.6
Acs. OOE	xx	xx	xx	411.8	411.8	xx	xx	139.1

(*) Less than .05.

(1) Eighty-four percent of farms reported workstock with an average of 2.2 for all farms.

(2) Other work for tractors consisted of pulling grain drill, side-delivery rake, and listing with disc hillers; for workstock, it consisted of pulling opening plow, turning plow (listing), and raking hay.

Table 11. Utilization of 115 medium tractors and workstock, by operation, on 103 farms, Upland areas, Mississippi, 1949.

Operation	Tractors					Workstock (1)		
	Percent of all farms rep't	Percent of all tractors rep't	Average			Percent of all farms rep't	Average	
			Per tractors rep't	All medium tractors	All farms in group		Per farm rep't	All farms in groups
Heavy work:								
Disc:	97	96						
10-hour days	xx	xx	16.6	15.9	18.2	xx	—	—
Acs. OOE	xx	xx	218.9	209.4	240.8	xx	—	—
Break:	51	52				8		
10-hour days	xx	xx	9.5	5.0	5.7	xx	24.1	1.9
Acs. OOE	xx	xx	69.6	36.3	41.8	xx	72.9	5.8
Bed:	55	50				29		
10-hour days	xx	xx	9.2	4.5	5.2	xx	12.7	3.7
Acs. OOE	xx	xx	145.2	72.0	82.8	xx	73.3	21.3
Combine, P.T.O.:	13	13						
10-hour days	xx	xx	5.2	.7	.8	xx	—	—
Acs. OOE	xx	xx	50.4	6.6	7.6	xx	—	—
Total heavy work:								
10-hour days	xx	xx	xx	26.1	29.9	xx	xx	5.6
Acs. OOE	xx	xx	xx	324.3	373.0	xx	xx	27.1
Light work:								
Plant	43	39				56		
10-hour days	xx	xx	5.5	2.2	2.5	xx	11.0	6.2
Acs. OOE	xx	xx	93.4	36.5	42.0	xx	74.8	41.9
Cultivate:	75	70				58		
10-hour days	xx	xx	21.9	15.4	17.7	xx	47.0	27.3
Acs. OOE	xx	xx	338.3	238.3	274.1	xx	238.1	138.1
Harrow:	67	63				13		
10-hour days	xx	xx	5.1	3.2	3.7	xx	8.6	1.1
Acs. OOE	xx	xx	151.0	94.5	108.7	xx	112.6	14.6

(Continued) Table 11. Utilization of 115 medium tractors and workstock, by operation, on 100 farms, Upland areas, Mississippi, 1949.

Operation	Tractors					Workstock (1)		
	Percent of all farms rep't	Percent of all tractors rep't	Average			Percent of all farms rep't	Average	
			Per tractors rep't	All medium tractors	All farms in group		Per farm rep't	All farms in groups
Mow:	33	31				31		
10-hour days	xx	xx	8.7	2.7	3.1	xx	3.8	6
Acs. OOE	xx	xx	164.0	51.3	59.0	xx	24.8	3.7
Fertilize:	12	10				20		
10-hour days	xx	xx	4.8	.5	.6	xx	9.7	1.9
Acs. OOE	xx	xx	69.2	7.2	8.3	xx	76.6	15.3
Combine, aux. motor:	3	3						
10-hour days	xx	xx	10.4	.4	.4	xx	—	—
Acs. OOE	xx	xx	102.4	3.6	4.1	xx	—	—
Belt work:	19	21						
10-hour days	xx	xx	10.7	2.2	2.6	xx	—	—
Haul:	33	33				18		
10-hour days	xx	xx	14.1	4.7	5.4	xx	17.4	3.1
Other work: (2)	24	23				6		
10-hour days	xx	xx	14.2	3.3	3.8	xx	3.0	.2
Acs. OOF	xx	xx	67.3	14.1	16.2	xx	32.7	1.0
Total light work:								
10-hour days	xx	xx	xx	34.6	39.8	xx	xx	40.4
Acs. OOE	xx	xx	xx	445.5	512.3	xx	xx	214.6
Total work:								
10-hour days	xx	xx	xx	60.7	69.7	xx	xx	46.0
Acs. OOE	xx	xx	xx	769.8	885.3	xx	xx	241.7

(1) Eighty-eight percent of farms reported workstock with an average of 4.5 for all farms.

(2) Other work for tractors consisted of raking and baling hay, pulling grain drill, corn picker, bull rake, and poisoning machine: other work for workstock consisted of raking hay, pulling lime spreader, and plowing garden.

Table 12. Utilization of 11 large tractors and workstock, by operations, on 11 farms, Upland areas, Mississippi, 1949.

Operation	Tractors					Workstock (1)		
	Percent of all farms rep't	Percent of all tractors rep't	Average			Percent of all farms rep't	Average	
			Per tractors rep't	All large tractors	All farms in group		Per farm rep't	All farms in groups
Heavy work:								
Disc:	100	100				—		
10-hour days	xx	xx	19.9	19.9	19.9	xx	—	—
Acs. OOE	xx	xx	405.3	405.3	405.3	xx	—	—
Break:	45	45				—		
10-hour days	xx	xx	10.0	4.5	4.5	xx	—	—
Acs. OOE	xx	xx	86.4	39.3	39.3	xx	—	—
Bed:	36	36				27		
10-hour days	xx	xx	17.0	6.2	6.2	xx	44.3	12.1
Acs. OOE	xx	xx	259.0	94.2	94.2	xx	241.0	65.7
Combine, P.T.O.:	27	27				—		
10-hour days	xx	xx	5.2	1.4	1.4	xx	—	—
Acs. OOE	xx	xx	60.0	16.4	16.4	xx	—	—
Total heavy work:								
10-hour days	xx	xx	xx	32.0	32.0	xx	xx	12.1
Acs. OOE	xx	xx	xx	555.2	555.2	xx	xx	65.7
Light work:								
Plant:	—	—				54		
10-hour days	xx	xx	—	—	—	xx	33.4	9.1
Acs. OOE	xx	xx	—	—	—	xx	176.3	96.2
Cultivate:	54	54				64		
10-hour days	xx	xx	16.2	8.8	8.8	xx	138.6	88.2
Acs. OOE	xx	xx	307.3	167.6	167.6	xx	659.9	419.9
Harrow:	54	54				27		
10-hour days	xx	xx	6.2	3.4	3.4	xx	17.7	4.8
Acs. OOE	xx	xx	239.0	130.4	130.4	xx	266.7	72.7

(Continued) **Table 12. Utilization of 11 large tractors and workstock, by operations, on 11 farms, Upland areas, Mississippi, 1949.**

Operation	Tractors					Workstock (1)		
	Percent of all farms rep't	Percent of all tractors rep't	Average			Percent of all farms rep't	Average	
			Per tractors rep't	All large tractors	All farms in group		Per farm rep't	All farms in groups
Mow:								
10-hour days	xx	xx	8.6	1.6	1.6	xx	5.0	.5
Acs. OOE	xx	xx	162.5	29.5	29.5	xx	25.0	2.3
Fertilize:								
10-hour days	xx	xx	—	—	—	xx	20.7	5.6
Acs. OOE	xx	xx	—	—	—	xx	165.7	45.2
Belt work:	27	27				—		
10-hour days	xx	xx	9.3	2.5	2.5	xx	—	—
Haul:	18	18				27		
10-hour days	xx	xx	30.0	5.5	5.5	xx	33.7	9.2
Other work:	18	18				—		
10-hour days	xx	xx	6.3	1.2	1.2	xx	—	—
Acs. OOE	xx	xx	80.0	7.3	7.3	xx	—	—
Total light work:								
10-hour days	xx	xx	xx	23.0	23.0	xx	xx	117.4
Acs. OOE	xx	xx	xx	334.8	334.8	xx	xx	636.3
Total work:								
10-hour days	xx	xx	xx	55.0	55.0	xx	xx	129.5
Acs. OOE	xx	xx	xx	890.0	890.0	xx	xx	702.0

(1) One hundred percent of farms reported workstock with an average of 10.5 per farm.
(2) Other work consisted of pulling grain drill and hay baler.

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Phosphate Fertilizers

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

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TABLE OF CONTENTS

Page

Abstract 5

Rates and Sources of Phosphate 5
  Cotton 5
  Oats 5
  Pastures 5
  Vetch 5
  Soybeans 6
  Sericea 6
  Alyce clover 6
  Corn 6

Rock Phosphate and Colloidal Phosphate 6

High Analysis Fertilizer 6

Crop Response to Phosphate 7
Cotton Response to Phosphate 7

Rates of Phosphate for Row Crops and Pastures 9
  Cotton 9
  Oats 10
  Pastures, Spring and Summer 11
  Pastures, Winter, Oats 12
  Pastures, Winter Vetch 13

Description of Materials 13
  Basic Slag 14
  Bone Meal 14
  Calcium Metaphosphate 14
  Colloidal Phosphate 14
  Concentrated Superphosphate 14
  Dicalcium Phosphate 14
  Fused Tricalcium Phosphate 14
  Monocalcium Phosphate 14
  Potassium Metaphosphate 14
  Rock Phosphate 15
  Superphosphate 15
  Tricalcium Phosphate 15
  Gypsum 15

Efficiency of Various Phosphates for Row Crops 15

Cotton and Corn Experiments Before 1934 16

Cotton and Corn Experiments from 1934-1947 16
  Sources of Phosphorus for Cotton 16
  Other Sources of Phosphorus for Cotton 16
  Cotton, Vetch Rotation 17
  Corn, Vetch Rotation 17

Cotton Experiments After 1947 19
  Cotton Response to Superphosphates, Fused Phosphates, and Calcium Metaphosphates 19

TABLE OF CONTENTS—(Continued)

Page

Efficiency of Various Phosphates for Pasture and Forages 20
  Sources of Phosphorus for Cowpeas 20

 Pasture and Forage Crop Experiments from 1934-1947 20
  Basic Slag, Colloidal Phosphate, and Superphosphate for Pasture 20
  Forage Crop Response to Various Phosphates and Lime 20

 Pasture and Forage Crop Experiments After 1947 21
  Various Phosphates for Winter Pasture 21
  Various Phosphates for Spring and Summer Pasture 22

Colloidal, Rock, and Superphosphate Comparisons 23

 Rock Phosphate Experiments Before 1934 23
  Superphosphate and Colloidal Phosphate for Corn 24
  Rock Phosphate, Superphosphate, and Colloidal Phosphate for Cotton 24
  Rock Phosphate, Basic Slag and Superphosphate for Cowpeas 25

 Rock Phosphate Experiments from 1934 to 1947 25
  Rock Phosphate and Superphosphate for Cotton 25
  Colloidal Phosphate, Basic Slag, and Superphosphate for Pastures 26

 Rock Phosphate and Colloidal Phosphate Experiments after 1947 26
  Rock Phosphate for Clover Pastures 26
  Colloidal Phosphate for Winter Oat Pastures 26
  Mixing Rock and Colloidal with Superphosphate for Fescue 26
  Mixing Rock and Superphosphate for Wheat Pasture 27

Residual Effect of Phosphate Fertilizers 28
  The Residual Availability of Phosphates to Cotton 28
  Residual Availability of Superphosphate for Pasture 30

Phosphate in High Analysis Fertilizer 31

 Description of Materials 31
  Nitric Phosphate 31
  Ammoniated Superphosphate 31
  Ammonium Phosphate 31

 Cotton Response to High Analysis Fertilizer 31

 Winter Oat Pasture Response to High Analysis Fertilizers 33

PHOSPHATE FERTILIZERS

By U. S. JONES*

ABSTRACT

Since 1887 over 1500 field crop experiments have been conducted in Mississippi to determine the kind and amount of phosphate fertilizer needed for the production of cotton, oats, corn, vegetables, vetch, soybeans, clover, and pastures. The results from these experiments are summarized below. These summary statements for the most part are based on the results of replicated experiments conducted since 1940 in the Hill Section. Some of the data did not allow a statistical evaluation of reliability.

Cotton: The greatest average return per pound of P_20_5 in the fertilizer was obtained with the first increment of 24 pounds of P_20_5 per acre per year. Yield of seed cotton was increased 225 pounds per acre by this treatment. On black prairie soils a further increase was obtained with a rate of 48 pounds of P_20_5 per acre. A soil limed to near neutrality was found to be optimum for cotton production; and at pH 6.0 to 7.0, 24 pounds of fertilizer phosphate was as efficient for cotton production as 48 pounds at pH 5.1.

Relative yield increase values of the various kinds of phosphate for cotton follow: Superphosphate 100, concentrated superphosphate 83, 10 mesh calcium metaphosphate 74, 40 mesh fused tricalcium phosphate 69, and 10 mesh fused tricalcium phosphate 69. These experiments suggest that a portion of the yield increase obtained with superphosphate was the result of the calcium and sulfur contained therein and not to phosphorus alone.

Oats: The greatest average return per pound of P_20_5 in the fertilizer was obtained with the first increment of 60 pounds of P_20_5 per acre per year. This was true whether the oats were harvested for grain or used as a forage or winter grazing crop. Yield of oat grain was increased 12 bushels and yield of dry oat forage was increased 768 pounds by 60 pounds of P_20_5.

Relative yield increase values for the different kinds of phosphate for oat forage follow: Concentrated superphosphate 100, calcium metaphosphate 101, 40 mesh fused tricalcium phosphate 99, 10 mesh fused tricalcium phosphate 86.

Pastures: The greatest average return per pound of P_20_5 in the fertilizer was obtained with the first increment of 30 pounds per acre each year on soil limed to near neutrality. The yield of dry pasture forage was increased 1.1 tons per acre by the addition of 60 pounds of P_20_5. The results clearly indicated that one pound of fertilizer phosphate produced more herbage at pH 6.3 than did 3 pounds at pH 5.2.

Relative yield increase values of the various kinds of phosphate on limed pastures follow: Superphosphate 100, concentrated superphosphate 86, 40 mesh fused tricalcium phosphate 81, 10 mesh fused tricalcium phosphate 66. These experiments and others that follow suggest that a portion of the yield increase obtained with superphosphate resulted from the sulfur contained therein and not to phosphorus alone.

Vetch: The greatest average return per pound of P_20_5 in the fertilizer was obtained with the first increment of 45 pounds per acre. This amount effected an increase of 1,597 pounds of green vetch per acre. At several locations further increases in vetch yield were obtained with rates of P_20_5 up to 90 or 120 pounds per acre.

In a vetch forage test on sandy soil, which was limed with a ton of calcium silicate slag, relative yield increase values of the various phosphates for vetch follow: Superphosphate 100, 40 mesh fused tricalcium phosphate 83, concentrated superphosphate 80, 10 mesh fused tricalcium phosphate 79.

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*Author compiler, see acknowledgement.

Soybeans: On sandy soils, limed with a ton of calcium silicate slag, in East Mississippi, the relative yield increase values of the various phosphates for soybeans were as follows: Superphosphate 100, concentrated superphosphate 74, 40 mesh fused tricalcium phosphate 66, 10 mesh fused tricalcium phosphate 56.

Sericea: On limed sandy soils the relative yield increase values of the various phosphates for sericea follow: Superphosphate 100, 10 mesh fused tricalcium phosphate 106, concentrated superphosphate 78, and 40 mesh fused tricalcium phosphate 69.

Alyce clover: On a limed sandy soil in South Mississippi the relative yield increase values of the various phosphates for Alyce clover follow: Superphosphate 100, 10 mesh fused tricalcium phosphate 89, 40 mesh fused tricalcium phosphate 77, and concentrated superphosphate 71.

Corn: In a corn-vetch rotation the vetch was fertilized with 43 pounds of P_20_5 each year. The corn was fertilized with nitrogen only. Under these conditions relative yield values of the various phosphates for corn follow: Superphosphate 100, basic slag 111, dicalcium phosphate 100, concentrated superphosphate 89, calcium metaphosphate 89.

Rock Phosphate and Colloidal Phosphate

The following summary statements include all of the experimental data available. Relative yield values for these materials are based on the increased yield from superphosphate as 100:

1. Rock phosphate added at a double rate of P_20_5 produced relative yield increases of 54, 61 and 70 for cotton, pastures, and cowpeas, respectively.

2. Colloidal phosphate added at a double rate of P_20_5 produced relative yield increases of 35, 50, 58, and 58, for oats, corn, cotton, and pasture, respectively.

3. An average of three ten year tests with cotton showed the residual efficiency of rock phosphate to be one-half that of superphosphate. For the residual studies both materials were added at the same rate of P_20_5.

4. A seven-year test with cotton, corn, and cowpeas showed that rock phosphate added at a quadruple rate of P_20_5 produced as much cowpea hay as superphosphate, but produced 3 bushels less corn, and 51 pounds less seed cotton per acre.

High Analysis Fertilizer

1. Over a three year period at four locations high analysis fertilizer (mixtures containing more than 30 units of plant food) have produced as much cotton and oats as conventional type mixtures of the same ratio.

2. The better cotton yields were obtained with high analysis nitric phosphate fertilizers containing calcium and sulfur.

3. Earlier growth of winter oats and wheat was obtained with high analysis fertilizer having about one-half or more of its P_20_5 in water soluble form.

Since 1887 over 1500 field tests have been conducted in Mississippi to determine the phosphate needs of many crops. These tests have been conducted throughout the state by the Mississippi State College Agricultural Experiment Station. They have shown that unfertilized soils in the Hill section are now deficient in phosphate and have been since they were first cleared. The long-time tests indicate that row-crop land which has been fertilized with large amounts of an available phosphate, and has not eroded badly, contains more phosphate now than when first cleared.

In contrast, the soils of the Delta for the most part have never been, and are not yet deficient in phosphate. These good Delta soils do not contain more phosphate now than when first cleared as do some of the Hill soils, because very little phosphate has been added. Field and laboratory tests are being conducted by Mississippi Experiment Station workers each year in order to determine when the phosphate level of these soils might become critical. Results of 242 field tests with corn and cotton indicate that 15 to 20 percent of Delta soils need phosphate now. Results of chemical tests showed that of 2728 soil samples tested, 23 percent were low in available phosphate.

CROP RESPONSE TO PHOSPHATE

Experiments in the Hill section (Table 1) show that yields of pasture, forage, and several truck crops have been increased from 40 to 70 percent or more by phosphate fertilizers. Cotton, oats, and velvet bean yields have been increased about 25 percent while corn and sorghum silage yields have been increased less than the others, the increase being of the order of 15 percent. It should be pointed out that regardless of the response of silage crops to phosphate, the several tons of roughage that are harvested will after a few years deplete the soil of phosphate, potash, lime, and nitrogen. Forage and silage crops remove from the soil more phosphate, potash, and lime than do cotton, corn, and other crops grown for seed or fruit.

Results from the Delta experiments (Table 2) show that alfalfa yields have been increased 10 percent by phosphate fertilizer. All other crops tested have been increased less than 10 percent.

The key to efficient fertilizer usage, whether it be in the Delta or in the Hills, whether it be on good land or poor, is to have the soil tested.

Cotton Response to Phosphate

Of the 1500 field tests conducted to determine the phosphate needs of crops, 779, or more than half of them, involved cotton. For this reason a large area of the state has been included. By grouping the data from these tests according to soil areas of the state, an indication of the variability of response to phosphate within the state was obtained (Table 3). The rate of phosphate used varied from 30 to 40 pounds of P_20_5 per acre, which is equal to that found in 300 to 400 pounds of a 5-10-5 fertilizer.

Cotton yields on sandy soils in the Longleaf Pine, Northeast Highland, and Sand Clay Hill areas in the eastern half of the state were increased 40, 33, and 28 percent, respectively. Cotton yields in the Northeast Prairie on heavy soils were increased 22 percent by 38 pounds of P_20_5 in the fertilizer. Cotton yields in the Brown Loam area on silty soils were increased 20 percent by 36 pounds of P_20_5 in the fertilizer.

The number of tests from the Pontotoc Ridge area is too limited for generalization. The tests conducted in the Flatwoods area were on soils which were extremely acid. These factors should be considered in interpreting the yield data in Table 3, which show that phosphate increased the cotton yield 13 percent in the Flatwoods and 4 percent on the Pontotoc Ridge soils.

An average of all tests in the Hill section shows that 4.8 pounds of seed cotton were obtained for each pound of P_20_5 used in the 300 and 400 pounds of 5-10-5 fertilizer. In contrast, the average of all tests in the Delta shows a yield increase of 1.5 pounds of seed cotton for each pound of P_20_5 up to 40 pounds per acre (Table 3). As stated before only 15 to 20 percent of the Delta soils on which tests were conducted needed phosphate, so the average figure means very little as regards any specific situation.

Many of the soils in the east Delta are older than those in the west Delta, and they are sometimes mixed with soil washed down from the hills. For these reasons the 242 tests conducted in the Delta were divided into those carried on in the east and those carried on in the west. Cotton yield in the eastern part of the Delta was increased an average of 5 percent while that in the west was increased 2 percent by the addition of 40 pounds of P_20_5 in the fertilizer (Table 3). These data are important in that they indicate that more phosphate deficient soils may be found in the eastern part of the Delta than in the western part.

Table 1. Crop response to phosphate in Hill section in Mississippi.

Crop	Product	Unit of yield	No. tests*	P_2O_5 added lb./A	Yield per acre		Increased yield due to phosphate		
					Average without phosphate	Average with phosphate	Per acre	Percent	Per lb. P_2O_5
Alfalfa	dry hay	lb.	10	114	3037	4616	1579	52	11.0
Alyce clover	dry hay	lb.	5	36	3286	4371	1085	33	30.1
Cabbage	100 heads	lb.	7	120	160	186	2570	16	21.4
Corn	shelled corn	bu.	111	39	27	31	4	15	0.1
Cotton	seed cotton	lb.	537	35	696	863	167	24	4.8
English peas	peas in pod	lb.	4	40	2139	3024	885	41	22.1
Lespedeza	seed	lb.	10	80	519	708	139	36	2.4
Lespedeza	dry hay	lb.	26	73	1570	2083	513	33	7.0
Oats	grain	bu.	71	35	24	31	7	29	0.2
Oat pasture	dry forage	lb.	65	46	1568	2474	906	58	20.0
Oat pasture	beef grains	lb.	2	60	198	296	98	50	1.6
Pasture, clover grass	dry forage	lb.	58	67	2718	4618	1900	70	28.0
Pasture, clover grass	beef gains	lb.	2	60	84	149	65	77	1.1
Peanuts	nuts	lb.	8	34	1004	1121	117	12	3.4
Sericea	dry hay	lb.	4	59	2214	4026	1812	82	31.0
Snapbeans	beans	lb.	8	58	2467	3459	992	40	17.1
Soybeans	dry hay	lb.	31	33	2882	3879	997	35	30.0
Sorghum	silage	ton	28	45	15	17	2	13	0.04
Strawberries	berries	qt.	5	66	2717	3309	592	22	9.0
Sweet potatoes	potatoes	bu.	68	40	156	177	21	13	0.5
Tomatoes	fruit	lb.	5	136	7446	10596	3150	42	23.2
Tung	nuts	lb.	3	60	248	701	453	183	7.5
Velvet beans	beans in pod	lb.	2	32	1840	2280	440	24	13.7
Vetch	green hay	lb.	117	45	4517	7260	2743	61	61.0

*A test is defined as one experiment at one location for one year.

Table 2. Crop response to phosphate in the Delta.

Crop	Product	Unit of yield	No. tests*	P_2O_5 added lb./A	Yield per acre		Increased yield due to phosphate		
					Average without phosphate	Average with phosphate	Per acre	Percent	Per lb. P_2O_5
Alfalfa	dry hay	lb.	3	90	9523	10469	946	10	10.5
Corn	shelled corn	bu.	50	50	65	68	3	3	0.06
Cotton	seed cotton	lb.	242	40	1651	1711	60	4	1.5
Soybeans	beans	bu.	3	80	27	28	1	1	0.01
Sweet potatoes	potatoes	bu.	8	48	325	346	21	6	0.4

*A test is defined as one experiment at one location for one year.

Table 3. Cotton response to phosphate in various soil areas of Mississippi. 779 tests—1889-1952.

Soil area	No. tests*	P_2O_5 added each yr. lb./A	Average yield of seed cotton: Without phosphate lb./A	With phosphate lb./A	Increase due to phosphate: Lb. per acre	Per-cent	Per lb. of P_2O_5
Longleaf pine	45	30	580	810	230	40	7.7
N. E. Highland	151	37	610	814	204	33	5.5
Sand clay hills	49	33	635	805	170	28	5.1
Flatwoods	67	33	654	742	88	13	2.7
N. E. Prairie	84	38	673	823	150	22	3.9
Brown loam	123	36	876	1050	174	20	4.8
Pontotoc ridge	18	32	908	941	33	4	1.0
HILL SECTION	537	35	696	863	167	24	4.8
East delta	106	40	1572	1658	86	5	2.1
West delta	136	40	1713	1754	41	2	1.0
DELTA	242	40	1651	1711	60	4	1.5

*A test is defined as one experiment at one location for one year.

Again it should be emphasized that the results reported here should be interpreted in the light of soil tests for a given field, and no attempt should be made to apply these average yield increased figures to a specific location.

The experiments described here have shown the response of crops to one average rate of phosphate. In order to determine the most profitable amount of phosphate to use for a given location, it is necessary to determine the response of a crop to a wide range of rates of applied P_20_5.

RATES OF PHOSPHATE FOR ROW CROPS AND PASTURES

In order to determine the response of crops and pastures to different rates of phosphate, experiments have been conducted in recent years in the Hill section with cotton, oats, vetch, winter grazing crops, and spring and summer pastures. Representative soils have been selected and the experiments for the most part have been conducted on Mississippi Branch Experiment Stations located at Holly Springs, Tupelo, Pontotoc, Brooksville, Newton, Raymond, and Poplarville. The soils included, among others, the following: Grenada, Pheba, Ecru, Houston, Prentiss, Loring, and Norfolk. These experimental fields have had excellent cultural practices such as weed and insect control, ample amounts of nitrogen for row crops, and good seed bed preparation.

Table 4. Rates of phosphate under cotton in the Hill section using in addition to the phosphate 36 pounds of N and 36 pounds K_2O.

Rates of P_2O_5 lb./A	Yield of seed cotton in lb./A: Brooksville 1948-51	Newton 1948-52	Raymond 1948-51	Average lb./A
0	624	885	794	777
24	925	990	1097	1002
48	975	1017	1080	1023

Cotton: In order to determine the quantity of phosphate required for cotton production, experiments were set up at Brooksville, Newton, and Raymond on Houston clay, Prentiss fine sandy loam, and Olivier silt loam, respectively (Table 4). The rates of phosphate used were 0, 24, and 48 pounds of P_20_5 per acre. In addition to the phosphate, 36 pounds of nitrogen and 36 pounds of K_20 per acre were used. The fertilizers were mixed and applied by hand in the row and then covered with a moldboard plow. The experimental design employed was a randomized block with five replications.

At Brooksville, 24 pounds of P_20_5 increased the yield of seed cotton 301 pounds, or from 624 to 925 pounds per acre. This experiment covered a four-year period from 1948 to 1951. At Newton, using a five-year (1948-52) average, 24 pounds of P_20_5 increased the yield of seed cotton 105 pounds per acre, or from 885 to 990 pounds per acre. At Raymond, for four years (1948-51), 24 pounds of P_20_5 added each year increased the yield of seed cotton 303 pounds, or from 777 to 1002 pounds per acre.

At none of the locations referred to above did the 48 pound rate of P_20_5 increase the yield over that obtained with the 24 pound rate by more than

50 pounds of seed cotton per acre. The results of these experiments indicate that for cotton the average yield increase per pound of phosphate in the fertilizer would be obtained with a rate approaching 24 pounds of P_2O_5 per acre (Table 4). If the lack of nitrogen, potash, lime or sulfur limits the growth of cotton, the phosphate will be less effective.

Another experiment involving the response of cotton to 0, 24, 48 pounds of P_2O_5 was established at Holly Springs on Grenada silt loam, which had been limed to pH 5.1, pH 6.0, pH 6.5, pH 7.0, and pH 8.0 in 1943 (Table 5). The purpose of this experiment was to determine the optimum pH for cotton production and the influence of lime on the availability of applied phosphate. The test has been in progress continuously for nine years, 1944-52. Nitrogen and potash were added from 1944 to 1950 at rates of 36 pounds per acre. After 1950, 48 pounds of nitrogen was applied. Enough lime was added each year to neutralize the acid forming effects of the nitrogen. Each year the fertilizer was banded in the row and covered with a moldboard plow. The experimental design was randomized split plots in which the whole plots were fertilizer rates and the split plots were different pH levels. The results of this experiment on the unlimed soil show an increase of 30 pounds of seed cotton for the 24 pound rate of P_2O_5. For the next P_2O_5 rate of 48 pounds, there was an increase of 155 pounds of seed cotton over that produced by 24 pounds of P_2O_5. On the soil limed to a pH of 6.0, the 24 pound rate of P_2O_5 increased the yield by 69 pounds of seed cotton and there was no further increase for the 48 pound P_2O_5 rate. This indicated that lime probably increased the availability of the soil phosphate and improved the efficiency of the fertilizer phosphate. The results of this experiment showed that a pH of 6.0 to 7.0 was optimum for cotton production on Grenada silt loam. The data further indicated that one pound of fertilizer phosphate produced more cotton at pH 6.0 than did two pounds at pH 5.1.

Table 5. Rates of phosphate and lime under cotton at Holly Springs, 1944-52.

Rates of P_2O_5* lb./A	Average yield in pounds of seed cotton on fields limed** to pH as follows:				
	pH 5.1 lb./A	pH 6.0 lb./A	pH 6.5 lb./A	pH 7.0 lb./A	pH 8.0 lb./A
0	879	1095	1026	1003	966
24	909	1164	1104	1120	952
48	1064	1141	1146	1175	1059

*Also fertilized with 36 pounds of N and 36 pounds of K_2O until 1950. After 1950 48 pounds of N was used.

** pH 5.1, no lime; pH 6.0, 1805 pounds lime; pH 6.5, 2566 pounds; pH 7.0, 3391 pounds; pH 8.0, 6803 pounds. Lime added in 1943. Enough lime was added each year thereafter to neutralize physiological acidity of the added nitrogen.

Oats: For the purpose of determining the amount of phosphate needed for oat grain production, tests were conducted at Holly Springs, Newton, Raymond, and Pontotoc on Grenada silt loam, Prentiss fine sandy loam, Olivier silt loam, and Ecru silt loam, respectively (Table 6). The rates of phosphate were 0, 60 and 120 pounds of P_2O_5 per acre. In addition to the phosphate, 120 pounds of nitrogen and 50 pounds of K_2O were used. Sixty pounds of the nitrogen was added in the fall and 60 pounds top dressed in March. The fertilizers added in the fall were broadcast by hand on the surface of the ground and then disked in lightly. It should be pointed out that recent work involving the effect of placement of fertilizer for oats indicates that fertilizer applied in bands 8 to 16 inches apart, a few inches below the surface and to the side of the seed, improved the efficiency of the fertilizer. The design of these experiments was randomized blocks with five replications.

At Holly Springs, 60 pounds of P_2O_5 increased the yield of oats by 12 bushels, or from 48 to 64 bushels per acre. At Newton, 60 pounds of P_2O_5 increased the yield by 13 bushels, or from 35 to 48 bushels per acre. At Raymond,

Table 6. Phosphate rates for oat grain production in the Hill section using in addition to the phosphate, 120 pounds of nitrogen and 50 pounds of potash per acre.

Rates of P_2O_5 lb./A	Yield of oat grain in bu./A				
	Holly Springs 1951	Newton 1951-52	Raymond 1951-52	Pontotoc 1952	Average lb./A
0	48	35	42	46	41
60	60	48	56	48	53
120	64	52	59	50	56
L.S.D. .05	12	12			

Table 7. Phosphate (P_2O_5) rates for white clover, lespedeza, dallis grass pastures grown on limed soils in Hill section of Mississippi. Lime and fertilizer incorporated in surface six inches of soil at planting. Fertilizer top dressed each year thereafter.

Annual rates of P_2O_5* lb./A	Yield of pasture forage in lbs./A at:						
	Newton 1948-51	Raymond 1950-51	Brooksville 1950-51	Tupelo 1950-51	Holly Springs 1950	Poplarville 1950	Average lb./A
0	2182	4683	1496	3783	6241	565	2955
30	4147	6072	3301	5049	6906	1005	4445
60	5164	6780	4872	4880	6944	1343	5167
90	5265	7076	4823	4774	6573	1787	5231
L.S.D. (.05)	225	349	206				

*Also limed to pH 6.0 at planting. Also received 100 lbs. potash per acre.

the same amount of P_20_5 increased the yield by 14 bushels or from 42 to 56 bushels per acre. At Pontotoc the increase was 2 bushels which is probably within the limits of experimental error.

At neither location has the 120 pound rate of P_20_5 increased the yield more than 4 bushels per acre over that obtained with the 60 pound rate. The results of these experiments show that the greatest increase in yield per pound of phosphate in the fertilizer was obtained from a rate of about 60 pounds of P_20_5.

Pastures, Spring and Summer: In order to determine the amount of phosphate needed for white clover, dallis grass, and lespedeza pastures, experiments have been conducted at Newton, Raymond, Brooksville, Tupelo, Holly Springs, and Poplarville on Prentiss, Olivier, Falls, Tilden, Grenada, and Bowie soils, respectively (Table 7). The rates of phosphate were 0, 30, 60, and 90 pounds of P_20_5 per acre added annually. The soil was limed to pH 6.0 to 6.5 at planting time. Each year 100 pounds of muriate of potash has been added. The fertilizer and lime were broadcast by hand on the surface of a well-prepared seed bed and disked into the top six inches the first year. Subsequent additions of phosphate and potash fertilizers have been top dressed by hand each year in the spring. There were six replications in a split plot design with the sub-plots being fertilizer combinations and the whole plots being frequency of application. Space does not permit discussion of the frequency of application here. However, 60 pounds of P_20_5 applied every year for three years produced significantly more forage than 180 pounds applied once at the beginning of the three year period. Results reported here are those from the plots receiving the fertilizer every year.

At Newton, Raymond, and Brooksville there were significant increases in yield up to 60 pounds of P_20_5 per acre. Difference in yields between 60 and 90 pounds of P_20_5 was not significant at these or any of the other locations (Table 7). There was a marked increase for all rates of P_20_5 at Poplarville, but the yields were considerably lower than at the other locations.

At Holly Springs and Tupelo marked increases in yield of pastures were evident for the 30 pound P_20_5 rate, but no additional increase was apparent for the 60 and 90 pound rate. The field at Holly Springs had been fertilized in recent years, and at the time of planting, 45 pounds of dilute acid soluble phosphate was present in the soil.

The results of these experiments indicate that for pastures, the greatest average yield increase per pound of phosphate in the fertilizer was obtained with the first increment of 30 pounds per acre of P_20_5 added each year on limed soils. If the lack of lime, potash, or inoculation limits the growth of pasture, the return from the phosphate will be less.

Another experiment to study the response of pastures to 0, 40, 80, and 120 pounds of P_20_5 per acre was established at Raymond on limed and unlimed Olivier silt loam. The unlimed soil was pH 5.2 and the limed soil was pH 6.3 (Table 8). The cultural practices and experimental design were the same as described above for the other white clover, dallis grass, lespedeza pasture experiments. This test has been carried on for five years and three clippings have been made each year to simulate grazing.

The results of this experiment show significant and progressive increases from the 40 and 80 pound rates of phosphate on the unlimed (pH 5.2) soil. The increase of 429 pounds of forage effected by the 120 pound rate over the 80 pound rate of P_20_5 is a significant difference on the unlimed soil at odds 10 to 1. In contrast, on the limed soils (pH 6.3) a significant increase was obtained for the 40 pound rate of P_20_5 over the check (no P_20_5); no significant increase was obtained from either the 80 pound rate over the 40 pound rate or the 120 pound rate over the 80 pound rate. However the 120 pound rate was significantly greater than the 40 pound rate. The yield of 4537 pounds of dry forage on the limed soil with a 40 pound rate of P_20_5 was equal, within the limits of experimental error, to the 4462 pounds of forage produced on the acid soil with 120 pounds of P_20_5 (Table 8).

In the experiment previously reported concerning the influence of lime on utilization of phosphate by cotton, the data indicated that one pound of fertilizer phosphate produced more cotton at pH 6.0 than did two pounds at pH 5.1. For pastures these results clearly indicated that one pound of fertilizer phosphate produced more herbage at pH 6.3 than three pounds did at pH 5.2.

That lime improved the efficiency of phosphate fertilizer to the extent that one pound of phosphate on a limed soil (pH 6.0 - 6.5) equalled two to three pounds on an acid soil (pH 5.0 - 5.3) was clearly evident from the results of these experiments.

Pastures, Winter, Oats: Experiments were inaugurated in 1948 to determine the amount of phosphate needed by winter oat pastures. The first three years, 1948-50, the oats were cut for forage in February or March, then top dressed with nitrogen, and harvested for grain in June. On the whole, this practice was not very successful, and it was concluded that it would be better to split the field, allowing a portion of the oats to be grazed as long as needed, and allowing the other part of the field to be used only for grain production. To this end, the experiments were modified and in 1951 and 1952 grain was harvested from one plot and forage from another (Table 9). The design of the experiment was randomized blocks with five replications. In addition to the nitrogen and phosphate, 50 pounds of K_20 was used. With high rates of nitrogen it is usually necessary to apply potash for oat production on sandy soils. The fertilizers were broadcast by hand on the surface of the ground and disked in lightly. Sixty pounds of nitrogen was added in the fall with the phosphate and potash. An additional sixty pounds of nitrogen was top dressed on the oats in March. It should be pointed out that the results of fertilizer placement experiments with oats have indicated that the efficiency of the fertilizer could be improved upon by placing it in bands as long as it is not placed directly in contact with the seed.

At Holly Springs on Grenada silt loam, 60 pounds of P_20_5 increased the

Table 8. Rates of phosphate and lime on white clover, dallis grass, lespedeza pasture, 1948-52, Raymond.

Annual rates of P_20_5* lb./A	Dry forage yields in pounds per acre on fields limed** to:	
	pH 5.2	pH 6.3
0	2677	3329
40	3550	4537
80	4023	4729
120	4462	5136
L.S.D. .05	491	491

*Phosphate and 100 pounds of K_20 applied annually.

**pH 5.2, no lime; pH 6.3, 2000 lbs./A. Lime and fertilizer disced in a well prepared seed bed in 1948. Fertilizer top dressed thereafter.

Table 9. Phosphate rates for winter oat pasture in the Hill section.

Annual rates of P_20_5* lb./A	Yield of dry oat forage** in lbs. per acre				
	Holly Springs 1948-52	Newton 1948-52	Raymond 1948-52	Tupelo 1949-50	Average lb./A
0	1413	1221	1772	245	1325
60	2036	1790	2528	1902	2093
120	2191	2016	2676	2058	2267

*Also received 45 pounds of N in 1948, 1949, and 1950; received 120 pounds of N in 1951 and 1952. Fifty pounds K_20 were also added with the P_20_5.

**From 1948 to 1950 oat grain and forage were taken from the same plots; after 1950 oat grain and oat forage were harvested from different plots.

yield of forage 623 pounds, or from 1413 pounds to 2036 pounds per acre (Table 9). At Newton on Prentiss fine sandy loam, 60 pounds of P_20_5 increased the yield of forage 569 pounds or from 1221 to 1790 pounds per acre. The increase in oat forage effected by 60 pounds of P_20_5 at Raymond on Olivier silt loam was 756 pounds, or from 1772 to 2528 pounds per acre for a five year period. At Tupelo on Tilden fine sandy loam, 60 pounds of P_20_5 increased dry oat forage 1657 pounds, or from 245 to 1902 pounds per acre.

At no location did the 120 pound rate of P_20_5 increase the yield of oat forage over that obtained with the 60 pound rate by more than 226 pounds per acre. The results of these tests indicate that for oat forage, the greatest average yield increase per pound of phosphate in the fertilizer, was obtained with a rate of about 60 pounds of P_20_5 per acre. If the lack of nitrogen, potash, or lime limits the growth of oats, the efficiency of the phosphate will be decreased. Good seed bed preparation and early September planting of oats are essential for high production of winter oat pastures.

Pastures, Winter, Vetch: Vetch is often grown with oats for winter pastures or alone in a corn or cotton rotation. In order to determine how much phosphate is needed for vetch, experiments were carried out during the period from 1941 to 1944 at Smithville, Columbus, Aberdeen, Amory, Poplarville, Holly Springs, and Raymond (Table 10). The soils were respectively Kalmia, Paden, Cahaba, Amite, and Ruston fine sandy loams and Grenada and Olivier silt loams. The rates of phosphate used were 0, 45, 90, and 135 pounds of P_20_5 per acre. The soil was limed to a pH of 6.0 to 6.5 but no other soil amendments were used. The fertilizer was applied by hand in the row and covered with a moldboard plow.

At Smithville yields of vetch were progressively increased from the lowest rate of 45 pounds of P_20_5 per acre up to the highest rate of 135 pounds of P_20_5 per acre (Table 10). At Columbus, Poplarville, Holly Springs, and Raymond yields were progressively increased by rates of P_20_5 up to 90 pounds per acre. At Aberdeen and Amory 45 pounds of P_20_5 gave the greatest return per pound of P_20_5 added.

At only one location, Smithville on Kalmia fine sandy loam, did the vetch need 135 pounds of P_20_5. At Holly Springs, Raymond, Columbus, and Poplarville 90 pounds of P_20_5 was ample for vetch production, while 45 pounds of P_20_5 was sufficient at Amory and Aberdeen. The results of these experiments emphasize the need for testing the soil to determine the amounts of phosphate fertilizer which may be used most economically.

These tests have shown the rate of phosphate which was most practicable for various crops at several locations. In order to determine the best kind of phosphate to use, it is necessary to compare many different kinds for many years at many locations.

DESCRIPTION OF MATERIALS

Many soils in Mississippi are low in available phosphate and, therefore, large quantities of phosphate fertilizers are needed to obtain satisfactory crop yields. There are several kinds of phosphate materials presently being used and others that may be used in the future if found satisfactory. Among the materials in use today are basic slag, calcium metaphosphate, colloidal

Table 10. Response of vetch to rates of phosphate fertilizer at seven locations in the Hill section of Mississippi on limed soils, 1941-44.

Annual rates of P_20_5 lb./A	Yield of vetch in pounds of green hay per acre at:							Weighted Average lb./A	Increase lb./A
	Smithville 1941-44 lb./A	Columbus 1941-42 lb./A	Aberdeen 1941-42 lb./A	Amory 1941 lb./A	Poplarville 1941 lb./A	Holly Springs 1941-42 lb./A	Raymond 1941-44 lb./A		
0	4684	5400	3206	15888	11413	2620	5703	5706	—
45	6944	8376	4968	18544	11800	3420	6300	7303	1597
90	7640	10284	4584	18784	16920	5100	8076	8657	2951
135	8520	11520	5264	17552	18560	5134	7540	9012	3306

phosphate, concentrated superphosphate, fused tricalcium phosphate, rock phosphate, and ordinary superphosphate. These materials vary considerably in solubility and usually the more soluble in water, the more quickly it becomes available to plants. Citric acid and ammonium citrate are used in laboratory tests to determine availability of phosphate. The kind of crop and the soil on which it is grown influence to a considerable extent the availability of the different phosphate materials. Before discussing the comparative availability of these materials as measured by plant growth, the methods of preparation and some of the chemical properties of these fertilizers will be described briefly.

Basic Slag. A by-product of the manufacture of steel from phosphatic iron ores. Steel made from ores containing phosphorus is brittle unless the phosphorus is removed. Lime is used in the removal process. The resulting slag is finely ground for agricultural use. It contains 70 percent or more lime equivalent, and 8 to 12 percent total P_20_5, which is insoluble in water but largely soluble in citric acid. Basic slag should not be confused with blast furnace slag which is a calcium silicate and contains only 1.0 to 1.5 percent total P_20_5 and 80 percent lime equivalent.

Bone Meal. Of historical importance only. A product made by grinding animal bones that have been previously steamed to dissolve the glue. It contains 25 to 30 percent P_20_5 which is insoluble in water but soluble in citric acid.

Calcium Metaphosphate. This material is prepared by treating rock phosphate with hot gaseous P_20_5. The resulting slag is cooled and finely ground. It contains about 60 to 64 percent P_20_5 which is insoluble in water but soluble in ammonium citrate solution.

Colloidal Phosphate. It is a finely divided raw mineral phosphate clay. It is a by-product from the mining of Florida rock phosphate by a hydraulic process in which the fine material settles in ponds farthest from the washer and is later removed after the water has evaporated. It contains a relatively high proportion of clay and may be considered as rock phosphate diluted with colloidal material. It contains 18 to 23 percent P_20_5, most of which is insoluble in water or ammonium citrate.

Concentrated Superphosphate. Also known as "double," "triple," or "treble" superphosphate. It is made by treating rock phosphate with phosphoric acid. It may be regarded as equivalent to ordinary superphosphate from which most of the gypsum or land plaster has been removed. It may contain up to 10 percent gypsum and 42 to 52 percent P_20_5. It is largely monocalcium phosphate and most of the phosphorus is soluble in water.

Dicalcium Phosphate. This is a by-product from the manufacture of monocalcium phosphate for use in baking powder. It is also produced as an animal feed supplement. It is obtained by neutralizing with lime water the acid solution of phosphate rock or processed bone. It contains 40 to 50 percent P_20_5, nearly all of which is insoluble in water but soluble in ammonium citrate.

Fused Tricalcium Phosphate. When rock phosphate is heated in the presence of silica and steam to the fusion point practically all of the fluorine is expelled. This operation results in the formation of tricalcium phosphate, which is suitable as an animal feed supplement or as a phosphate fertilizer. It contains 27 to 28 percent P_20_5, none of which is soluble in water, but over half of which is soluble in ammonium citrate.

Monocalcium Phosphate. This material is quite similar to concentrated superphosphate, containing 42 to 52 percent P_20_5, practically all of which is soluble in water.

Potassium Metaphosphate. This material has considerable potential as a fertilizer material because it contains two nutrient elements, phosphorus and potassium. However, it has not been produced on a commercial scale in large quantities as yet. It contains about 50 percent P_20_5 and 35 percent K_20. It has been tested in the field with other materials that are presently on the market.

Rock Phosphate. This material occurs in natural deposits in Florida, Tennessee, Idaho, Montana, Utah, and Wyoming. The material is largely a mineral called fluorapatite which may be represented by the formula $(Ca_{10}F_2(PO_4)_6)$. A good grade of rock phosphate contains 32 percent P_2O_5. It is water insoluble and only slightly soluble in ammonium citrate. To be effective it must be finely ground and used on soils that are acid in reaction.

Superphosphate. Made by mixing together equal weights of rock phosphate and sulfuric acid. The resulting product consists of monocalcium phosphate and gypsum in about equal amounts. Ordinary superphosphate contains approximately 50 percent gypsum and 16 to 20 percent P_2O_5 most of which is soluble in water.

Tricalcium Phosphate. It may be made by treating phosphoric acid with lime water. It has been referred to as bone phosphate of lime. This material contains about 40 percent P_2O_5, none of which is soluble in water, but about half of which is soluble in ammonium citrate.

Gypsum. Because this material makes up one-half the weight of superphosphate, it is described briefly. It contains no phosphorus. It is the calcium salt of sulfuric acid. It is soluble to the extent of one pound in 1000 pounds of water and will furnish calcium and sulfur to plants.

EFFICIENCY OF VARIOUS PHOSPHATES FOR ROW CROPS

Phosphate fertilization has been long recognized as necessary for successful crop production in Mississippi. Results are recorded of experimental work with phosphate fertilizers as far back as 1887. Soon after the turn of the century, experiments with phosphate fertilizers were underway at Lake in Newton County, at Holly Springs in Marshall County, and at McNeill in Pearl River County. Since that time hundreds of experiments have been conducted by the agricultural experiment station. Because of the quantity of data available and the need for simplifying the presentation, the following procedure was adopted. The difference in yield between the no-phosphate treatment and the ordinary superphosphate treatment is given a rating of 100. The increase in yield over the no-phosphate effected by each of the various materials is then expressed as a percentage figure relative to 100 for ordinary superphosphate. Superphosphate is listed first in the table proper, and all other kinds of phosphate fertilizer are rated on the basis of their relative efficiency as compared to superphosphate. The materials listed under superphosphate in the tables are in the order of decreasing efficiency as phosphate fertilizers. As an example, see Table 11.

For convenience in discussing the data, the results of experiments are divided into those obtained using cotton and corn, and those obtained with pastures and forage crops. Another section deals with the response of crops and pastures to rock phosphate and colloidal phosphate. Still another deals with phosphate in high analysis fertilizers. Where applicable each of the above sections is subdivided into groups which include the results of experiments conducted (1) before 1934, (2) between 1934 and 1947, and (3) after 1947. Where possible conclusions were based on experiments conducted after 1947 because these experiments were designed in such a manner that a statis-

Table 11. Response of cotton and corn to superphosphate and bone meal at State College, 1887-1888.

Source of phosphorus	Total P_2O_5 added per A	Average yield per acre		Increase per acre due to P.		Relative efficiency (super = 100)	
		Corn*	Cotton*	Corn	Cotton	Corn	Cotton
	lb.	bu.	lb.	bu.	lb.		
Superphosphate	64	52	1860	17	375	100	100
Bone meal	92	49	1650	14	165	82	40
None	0	35	1485	—	—	—	—

*Preceded by clover; corn grown on hill land, cotton on bottom.

tical analysis could be applied to the results.

Cotton and Corn Experiments Before 1934

The oldest experiment recorded was started in 1887 on the State College Farm to determine the response of cotton and corn to superphosphate and bone meal (Table 11). This experiment was conducted for two years and the crops received no other fertilizer. Both the corn and cotton were preceded by clover. The corn was grown on hill land, probably Starkville sandy loam, and the cotton was grown on bottom land which today would be classed as a Leeper or Kaufman fine sandy loam. According to the results of this experiment, the relative yield increases for bone meal (largely tricalcium phosphate) based on the increased yield from superphosphate as 100 follow: Corn 82, and cotton 40.

Cotton and Corn Experiments from 1934-1947

Sources of Phosphorus for Cotton. An experiment was started in 1934 to determine the response of cotton to monocalcium, dicalcium, and tricalcium phosphates under a wide range of conditions (Table 12). Superphosphate was the standard source to which the other materials were compared. Superphosphate plus lime was also included to obtain a measure of the response of cotton to lime. The phosphate materials were included in a fertilizer mixed by experiment station workers and applied at a rate of 400 pounds of 4-8-4 per acre. Most of the nitrogen was derived from sulphate of ammonia, and all of the K_20 from muriate of potash. Cottonseed meal was used to make up 10 percent of the nitrogen. The fertilizer and lime were applied in the furrow and covered with a "middle buster" plow. There were four systematic replications of each treatment.

Under the conditions of these 63 tests with cotton, the relative yield increases for the various treatments, based on the increased yield from superphosphate as 100 are as follows: Superphosphate plus lime 139, monocalcium phosphate 105, dicalcium phosphate 100, and tricalcium phosphate 82. It is evident from these tests that cotton responded to lime and that the more soluble mono- and dicalcium phosphates were more available to cotton than tricalcium phosphate.

Other Sources of Phosphorus for Cotton. Another experiment was conducted from 1935 to 1939, under a wide range of conditions to determine the response of cotton to concentrated superphosphate, dicalcium phosphate, tricalcium phosphate, basic slag, and rock phosphate. Ordinary 20 percent superphosphate was the standard material to which the other sources were compared. Lime was added to concentrated superphosphate in another treatment to determine the response of cotton to lime, and to neutralize the acid-forming qualities of sulfate of ammonia which was the source of nitrogen in all of the fertilizers. K_20 was added as muriate of potash. All of the materials were mixed before planting and applied at a rate of 400 pounds of 4-8-4 fertilizer per acre. The fertilizer was applied in the furrow and covered with a "middle buster" plow. There were

Table 12. Cotton response to lime and to sources of phosphorus in 400 pounds of 4-8-4; 63 tests, 1934-39.

Source of phosphorus in 4-8-4**	Seed cotton	Increase over no phosphorus	Relative efficiency (Response to superphosphate = 100)
	lb./A	lb./A	
No phosphorus	645	—	—
Superphosphate	772	127	100
Superphosphate plus lime*	822	177	139
Monocalcium phosphate	778	133	105
Dicalcium phosphate	771	126	100
Tricalcium phosphate	749	104	82

*200 pounds of calcium lime added per acre per year.

**Sulfate of ammonia and muriate of potash used with the various phosphates to make up the 4-8-4 fertilizer, 400 pounds of which were added per acre each year.

two systematic replications of each treatment. The results are reported in Table 13.

According to these 97 tests with cotton the relative yield values of the various treatments based on the increased yield from superphosphate as 100 follow: concentrated superphosphate plus lime 140, basic slag 119, dicalcium phosphate 106, concentrated superphosphate 94, tricalcium phosphate 71, and rock phosphate 48. The results indicate that cotton responded to lime added as such and to that contained in basic slag. The sulfate in the ammonium sulfate should be sufficient to furnish the sulfur needs of the crop. Therefore, the difference in the repsonses of the sources are due to the calcium content, degree of soil acidity, or differences in solubility of the phosphorus. The more soluble concentrated superphosphate and dicalcium phosphate were more available to cotton than tricalcium phosphate or rock phosphate.

Corn, Vetch Rotation. This experiment was started in 1938 at a number of locations on sandy soils in Northeast Mississippi to determine the relative efficiency of various phosphate fertilizers on limed and unlimed soils. The lime applied to the vetch was drilled at a rate of 400 pounds of dolomite per acre. The vetch was also fertilized with 43 pounds of P_20_5 and 25 pounds of K_20. Corn was fertilized with 30 pounds of N from sulfate of ammonia, but all other fertilizer and lime were added to the vetch. The corn check plots received no fertilizer nitrogen, therefore, the increased yields of corn (Table 14) result from the addition of nitrogen as well as from the residual phosphate and potash added to the vetch. There were four systematic replications of these experiments. Results of 13 tests with corn and 20 with vetch are shown in Table 14.

The relative yield values of the various phosphates on limed soil, based on the increased yield of corn from superphosphate as 100 are as follows: concentrated superphosphate 89, calcium metaphosphate 89, dicalcium phosphate 100, and basic slag 111.

The relative yield values of the various phosphates on limed soil, based on the increased yield of vetch from superphosphate as 100 are as follows: concentrated superphosphate 106, calcium metaphosphate 103, dicalcium phosphate 104, and basic slag 121. The results of these tests indicate that basic slag was an excellent treatment for vetch. There was little difference in the efficiency of the other materials either for corn or vetch (Table 14). The corn growth was retarded by the lack of nitrogen. Under such conditions the sources of phosphorus were not adequately tested. The vetch growth on the unlimed soil was being retarded by the lack of lime. Under conditions of low calcium in the soil the yield responses to phosphorus sources were to some extent influenced by the calcium content of the various materials.

Cotton Vetch Rotation. An experiment designed to study the availability of fused tricalcium phosphate, potassium metaphosphate, and superphosphate as measured by increased yields of vetch and cotton was established in 1944 (Table 15). This test was conducted from 1944 to 1947 under a wide

Table 13. Cotton response to sources of phosphorus and lime in 400 pounds of 4-8-4, 97 tests, 1935-39.

Source of phosphorus in 4-8-4	Seed cotton	Increase over no phosphorus	Relative efficiency (Response to superphosphate = 100)
	lb./A	lb./A	
No phosphorus	563	—	—
Superphosphate	684	121	100
Conc. super plus lime*	733	170	140
Basic slag	707	144	119
Dicalcium phosphate	691	128	106
Conc. superphosphate	677	114	94
Tricalcium phosphate	649	86	71
Rock phosphate	621	58	48

*Dolomitic lime added at rate of 115 pounds per acre per year to neutralize acidity of $(NH_4)_2SO_4$, which was the source of nitrogen in the 4-8-4.

range of conditions on sandy loam soils in East Mississippi. In 1944 the phosphate and calcium silicate slag were put under the vetch. In 1945, 1946, and 1947, the nitrogen, phosphate, potash, and calcium silicate slag were put under cotton. In 1946, 500 pounds of 0-8-5 was put under vetch. The source of potash was 50 percent muriate of potash and the nitrogen was added as ammonium nitrate. There were four replications at each location. The experiments were conducted on sandy soils of pH 5.0 to 5.7 and low in available phosphate and potash. The results of 30 tests with cotton and 17 with vetch are presented in Table 15.

Relative yield increases of the various treatments, based on the increased yield of cotton from superphosphate as 100 follow: superphosphate plus lime 114, concentrated superphosphate 80, 40 mesh fused tricalcium phosphate 79, potassium metaphosphate 72, and 10 mesh fused tricalcium phosphate 70. Ordinary 20 percent superphosphate increased cotton yields 20 percent more than did concentrated superphosphate. This may be explained as being due to the gypsum content of the ordinary superphosphate. About one-half of ordinary superphosphate is gypsum which contains calcium and sulfur.

Concentrated superphosphate as used

Table 14. Crop response to calcium metaphosphate, dicalcium phosphate, superphosphates, and basic slag on limed and unlimed soils as measured by increased yields in 20 tests with vetch and 13 tests with corn following fertilized vetch on sandy soils in Northeast Mississippi, 1938-44.

Source of phosphorus	Yield increases over check		Relative efficiency of phosphates. (Response to superphosphate = 100)	
	Corn* lb./A	Green Wt. of vetch** lb./A	Corn	Vetch
		Unlimed Soils		
Check, no phosphate	18 [1]	1536 [1]	—	—
Superphosphate	9	2641	100	100
Conc. superphosphate	9	2635	100	100
Calcium metaphosphate	9	2474	100	94
Dicalcium phosphate	9	2622	100	99
Basic slag	10	3256	111	123
		Limed Soils***		
Check, dolomite	21 [1]	1747 [1]	—	—
Superphosphate	9	2798	100	100
Conc. superphosphate	8	2975	89	106
Calcium metaphosphate	8	2876	89	103
Dicalcium phosphate	9	2923	100	104
Basic slag	10	3006	111	121

*Thirty pounds of N as $(NH_4)_2SO_4$ to corn except the check, no phosphate; and the check, dolomite plots. The increased yields are, therefore, influenced by nitrogen and phosphate and not phosphate alone.

**Vetch fertilized with 43 pounds of P_2O_5 and 25 pounds of K_2O per acre annually.

***400 pounds of dolomite per year to vetch.

[1] Check yields are total yields per acre; all others are increases over check.

Table 15. Crop response to lime, fused tricalcium phosphate, potassium metaphosphate, and superphosphates as measured by increased yields in 17 tests with vetch and 30 tests with cotton on sandy loam soils in East Mississippi, 1944-47.

Source of phosphorus in fertilizer*	Yield increases** over check, lb./A		Relative efficiency of phosphates. (Response to superphosphate = 100)	
	Seed cotton	Green wt. of vetch	Cotton	Vetch
Check, no phosphorus	655 [1]	7465 [1]	rating	rating
Superphosphate	293	2731	100	100
Superphosphate plus lime*	335	2589	114	95
Conc. superphosphate	233	2518	80	92
Fused tricalcium phos. 40 mesh	231	2593	79	95
Potassium metaphosphate	211	2695	72	99
Fused tricalcium phos. 10 mesh	205	2785	70	102

*1944; 48 lbs. P_2O_5, 1000 lbs. calcium silicate slag to vetch.
1945; 500 lbs. 6-12-4, 2000 lbs., calcium silicate slag to cotton, nothing under vetch following cotton. N from NH_4NO_3; K_2O from muriate of potash.
1946; 500 lbs. 6-8-5, 2000 lbs. calcium silicate slag to cotton; 500 lbs. 0-8-5 under vetch. N from NH_4NO_3; K_2O from muriate of potash.
1947; 500 lbs. 6-8-5, 500 lbs. calcium silicate slag to cotton; vetch yields were not taken in 1947. N from NH_4NO_3; K_2O from muriate of potash..

**Weighted averages based on number of crops harvested; the experiment did not run the full time at all locations.

[1] Check yields are total yields per acre; all others are increases over check.

in these tests contained about one-third as much calcium as 20 percent superphosphate and little or no sulfur. The phosphorus in both materials was water-soluble and was added at the same rate. It is concluded that gypsum made the difference. It is not possible to determine from this experiment whether the calcium or sulfur in the superphosphate was more effective in increasing the yield, but the fact that further increases were obtained by adding lime as calcium silicate slag substantiated the need for calcium and indicates that a portion of the increase effected by the gypsum was due to its calcium content.

Cotton Experiments After 1947

Cotton Response to Superphosphates, Fused Phosphates, and Calcium Metaphosphates: This experiment was started in 1950 at Newton, Brooksville, Holly Springs, and Raymond on Prentiss fine sandy loam, Hunt clay, Grenada silt loam, and Olivier silt loam, respectively. All of the soils had pH values of less than 5.5 except the Hunt clay, which had a pH of 6.2. The available phosphorus in the soils by a dilute acid soluble method was as follows: Newton, 5 lbs./A; Brooksville, 7 lbs./A; Holly Springs, 17 lbs./A; and Raymond 11 lbs./A. Significant responses to phosphorus at odds 19:1 were obtained at all locations. The tests were conducted for three years (1950-52) at Newton, Brooksville, and Holly Springs, and for one year (1951) at Raymond. The fertilizers were made up with phosphorus from the various sources indicated, with nitrogen from ammonium nitrate and potash from muriate of potash. The experiments were arranged in randomized blocks with six to eight replications. The fertilizer, at the rate of 400 pounds of 10-10-10 per acre, was added by hand in the row middles and covered with a mold board plow. The results of these 10 tests with cotton are shown in Table 16.

Relative yield values from the various phosphates, based on the increased yield of superphosphate as 100 follow: concentrated superphosphate 83, 10 mesh calcium metaphosphate 74, 10 mesh fused tricalcium phosphate 71, and 40 mesh fused tricalcium phosphate 69. The better yield increases obtained with ordinary superphosphate was probably a result of its gypsum content.

Because of the high content of exchangeable calcium (29 m.e.) at Brooksville and the low content of exchangeable calcium (less than 2.05 m.e.) at the other locations, comparisons of ordinary superphosphate and concentrated superphosphate could be made on a soil containing sufficient calcium with a favorable reaction and on soils containing insufficient calcium with an unfavorable reaction. It should be pointed out in this connection that there was no difference in the two superphosphates at Brooksville where the calcium content of the soil was high, but at Newton, Holly Springs, and Raymond where the calcium content of the soil was low there was a difference in favor of ordinary superphosphate which contains more calcium than concentrated superphosphate. This would indicate that the calcium content of the gypsum in superphosphate was respon-

Table 16. Cotton response to superphosphates, fused phosphates, and calcium metaphosphate.

	Yield increases over check in pounds of seed cotton per acre at:				
Source of phosphorus**	Newton 1950-52	Brooksville 1950-52	Holly Springs 1950-52	Raymond 1951	Relative efficiency (Superphosphate = 100)
Check, no phosphate	407[1]	87[1]	794[1]	824[1]	—
Superphosphate	942	568	286	464	100
Conc. superphosphate	854	578	126	184	83
Calcium metaphosphate 10 M*	748	480	199	16	74
Fused tricalcium phos. 10 M*	757	323	201	332	71
Fused tricalcium phos. 40 M*	727	377	102	416	69
L.S.D. .05	81***	174	81***	241	—

*10 M means ground to pass a ten mesh screen: 40 M means ground to pass a 40 mesh screen.

**Added at rate of 40 lbs. P_2O_5 each year. Also received 40 lbs. N from NH_4NO_3 and 40 lbs. of K_2O from muriate of potash each year.

***Newton and Holly Springs yields analyzed together.

[1] Check yields are total yields per acre; all others are increases over check.

sible in part for the differences observed.

EFFICIENCY OF VARIOUS PHOSPHATES FOF PASTURE AND FORAGES

Sources of Phosphorus for Cowpeas. One of the oldest tests comparing superphosphate, basic slag, and rock phosphate was started at Holly Springs on an acid Richland silt loam in 1913 (Table 17). One-half of each plot was cut for hay, and on the other half peas were picked. There were two 1/20 acre "no fertilizer" check plots and one 1/20 acre plot consisting of four rows for each of the sources of phosphorus. None of the phosphate plots was limed. However, one plot not included in results shown in Table 17 had been treated with lime alone and good response to lime was obtained. The purpose of the test was to determine the relative values of the various sources of phosphate that were being marketed at that time. The phosphate materials were added at a rate of 200 pounds per acre per year.

Under the conditions of this three-year test with cowpeas, the relative yield values of the various phosphates based on the increased yield from superphosphate as 100 follow: basic slag 84 and rock phosphate 70. The P_2O_5 rates for superphosphate, basic slag, and rock phosphate were 32, 16, and 60 pounds per acre, respectively (Table 17).

Pasture and Forage Crop Experiments from 1934-1947

Basic Slag, Colloidal Phosphate, and Superphosphate for Pasture. This experiment was conducted at Holly Springs, Pheba, and Raymond on Grenada, Lufkin, and Olivier silt loam, respectively, from 1941 through 1946 (Table 18). The fertilizers were broadcast on top of the ground and worked into the soil. There were four replications of each treatment. The materials were applied annually at the following rates: 500 pounds of basic slag, 200 pounds of superphosphate, and 400 pounds of colloidal phosphate. The soils were acid and no lime was added.

Under the conditions of these pasture tests the relative yield values for the various phosphates based on the increased pasture yield from superphosphate as 100 follow: basic slag 112 and colloidal phosphate 58 (Table 18).

Forage Crop Response to Various Phosphates and Lime. During 1944 and 1945 experiments were conducted with vetch, soybeans, sericea, and alyce clover on sandy soils in East Mississippi to determine the relative efficiency of superphosphate, concentrated superphosphate, and fused tricalcium phosphates

Table 17. Response of cowpeas to 200 pounds of rock phosphate, superphosphate, and basic slag at Holly Springs—1913-1915.

Source of phosphorus	Annual rate of P_2O_5 per A	Cowpea yield per acre		Increased yield		Relative efficiency super = 100)
		Grain	Hay	Grain	Hay	
	lb.	bu.	lb.	bu.	lb.	
Superphosphate	32	22	3240	8	850	100
Basic slag	16	20	3100	6	710	84
Rock phosphate	60	19	2990	5	600	70
None	0	14	2390	—	—	—

Table 18. Response of pasture grasses and clovers to colloidal phosphate, basic slag, and superphosphate. Holly Springs, Pheba, and Raymond—1941-46.

Source of phosphorus*	Annual rate of P_2O_5 per A	Average green weight yield per acre of pasture	Increase per acre due to phosphate	Relative efficiency (super = 100)
	lb.	lb.	lb.	
Basic slag	40	8933	3853	112
Superphosphate	40	8517	3437	100
Colloidal phosphate	80	7083	2003	58
None	0	5080	—	—

*Materials added alone to pastures as follows: 500 lbs. basic slag, 200 lbs. of superphosphate, 400 lbs. of colloidal phosphate.

(Table 19). Vetch and sericea were grown on Prentiss fine sandy loam near Columbus, soybeans on Savannah fine sandy loam near Corinth, and alyce clover on Ruston sandy loam at Poplarville. Each treatment was replicated four times. Each phosphate material was tested on unlimed soil and on soil limed with 1000 pounds of calcium silicate slag. At all locations there was some response to calcium silicate slag. For this reason, the performance of the phosphate materials on limed soil will be discussed.

Under the conditions of these tests on limed soils with each forage crop, the relative yield values for the various phosphates based on the increased yield from superphosphate as 100 follow: Vetch—concentrated superphosphate 80, 40 mesh fused tricalcium phosphate 83, and 10 mesh fused tricalcium phosphate 79; Soybeans—concentrated superphosphate 74, 40 mesh fused 66, and 10 mesh fused 56; Serecia—concentrated superphosphate 78, 40 mesh fused 69, and 10 mesh fused 106; Alyce clover — concentrated superphosphate 71, 40 mesh fused 77, and 10 mesh fused 89 (Table 19).

These experiments show that ordinary 20 percent superphosphate produced around 20 percent more green forage than concentrated superphosphate on limed sandy soils. Because the phosphorus in both ordinary and concentrated superphosphates is equally soluble, the data indicated that gypsum in the ordinary superphosphate made the difference. As the soil was limed with 1000 pounds of calcium silicate slag, these results suggest that the sulfur in superphosphate is probably responsible for the increases in forage on these sandy soils (Table 19).

Pasture and Forage Crop Experiments After 1947

Various Phosphates for Winter Pasture. In 1950 experiments were established at Newton, Brooksville, and Holly Springs on Prentiss, Hunt, and Grenada soils, respectively (Table 20). These soils contained less than seven pounds of dilute acid soluble phosphorus except the Grenada soil which contained 13 pounds. The pH of the soils varied from 4.9 to 5.1, except for the Hunt clay which had a pH of 6.8 Fertilizer at the rate of 500 pounds of 12-12-12 was added annually. An additional 60 pounds of N was top dressed after the first harvest of forage, generally in February. All of the fertilizers were broadcast by hand. No lime was added. On two additional plots ordinary superphosphate and colloidal phosphate were added at the rate of 666 pounds and 1000 pounds per acre, respectively,

Table 19. Forage crop response to superphosphates and fused tricalicum phosphates on limed and unlimed sandy soils fertilized with 48 pounds of P_2O_5, 1944-45.

	Yield increases over check lbs. green forage per acre				Relative efficiency of phosphates (response to superphosphate = 100)			
Source of phosphorus	Vetch lb./A	Soy-beans lb./A	Sericea les-pedeza lb./A	Alyce clover lb./A	Vetch rating	Soy-beans rating	Sericea les-pedeza rating	Alyce clover rating
Check, lime*	7909 [1]	7295	4639	6687	—	—	—	—
Superphosphate plus lime	2098	1866	4443	11169	100	100	100	100
Conc. superphosphate plus lime	1679	1384	3460	8021	80	74	78	71
Fused tricalcium phos. 40 M** plus lime	1740	1236	3059	8561	83	66	69	77
Fused tricalcium phos. 10 M** plus lime	1649	1043	4702	9950	79	56	106	89
Check, no lime	7737 [1]	5322	3694	4871	—	—	—	—
Superphosphate	2600	3268	3483	10689	100	100	100	100
Conc. superphosphate	1926	2296	3247	7223	74	70	93	67
Fused tricalcium phos. 40 M	2136	2510	3353	7596	82	77	96	71
Fused tricalcium phos. 10 M	2428	1916	2663	7904	93	59	76	74

*1000 lb./A calcium silicate slag. It was top dressed on lespedeza sod. It was broadcast and worked into soil for the other crops.

**40 M means ground to pass a 40 mesh screen. 10 M means ground to pass a 10 mesh screen.

[1] Check yields are total yields per acre; all other yields are increases over the check.

along with the same amount of nitrogen and potash that was used with the other sources of phosphorus. These amounts of colloidal phosphate and superphosphate were broadcast on the plots in 1950 and no additional phosphate has been added to them. The experimental design was randomized blocks with four replications. Results in 1952, and those in 1953 not reported here show that neither superphosphate nor colloidal phosphate added once, at the rates used, is capable of maintaining good yields of winter pasture for four years. Annual applications of superphosphate or concentrated superphosphate at the rate of 60 pounds per acre were essential for good growth every year.

Because ordinary superphosphate was applied in a different manner and at a different rate from the other sources, the standard for comparison in this experiment was concentrated superphosphate. Based on these 6 tests with winter pastures the relative yield values for the various phosphates based on the increased yield from concentrated superphosphate as 100 follow: calcium metaphosphate 101, 40 mesh fused tricalcium phosphate 99, 10 mesh fused tricalcium phosphate 86. The relative values for superphosphate and colloidal phosphate are respectively 92 and 35 (Table 20).

These tests with winter oat pastures were conducted so that a measure of the earliness in growth, as influenced by the various phosphates, could be obtained. The data in Table 20 are average results for the full years' production. Space does not permit a discussion or tabulation of the data by clippings. It should be pointed out, however, that the early growth of winter oats fertilized with materials containing a high percentage of water-soluble phosphorus, such as ammo-phos, concentrated superphosphate, and ordinary superphosphate, was frequently greater than that produced with the water-insoluble phosphates such as the fused tricalcium phosphate. This would permit more grazing during the early winter.

Various Phosphates for Spring and Summer Pasture. In 1948, experiments were established at Newton, Raymond, and Brooksville on Prentiss fine sandy loam, Olivier silt loam, and Falls clay, respectively (Table 21). These soils contained respectively 15, 4, and 18 pounds of dilute acid soluble phosphorus per acre. The pH of the Falls clay was 5.6 and that of the other two soils 5.2. All the soils were limed to about pH 6.0. The fertilizers were 40 pounds of $P_2 0_5$ and 50 pounds of $K_2 0$ added as annual applications. The fertilizers and lime were broadcast by hand in April onto a well prepared seed bed and disced into the surface four inches of the soil. The land was then cultipacked, seeded to Dallis grass and lespedeza, and cultipacked again. White clover was seeded the following fall. Subsequent top dressings of phosphate and potash have been made each year thereafter. No further additions of lime have been made. The design

Table 20. Response of winter oat pasture to calcium metaphosphate, superphosphates, fused phosphates, and colloidal phosphate.

Source of phosphorus*	Yield increases over check in pounds of dry forage at: Newton 1950-52	Brooksville 1952	Holly Springs 1951-52	Relative efficiency (conc. super = 100)
Check, no phosphate	1114 [1]	1401 [1]	3276 [1]	—
Conc. superphosphate	2050	3622	699	100
Calcium metaphosphate	1981	3707	828	101
Fused tricalcium phos. 40 M	1890	3622	876	99
Fused tricalcium phos. 10 M	1428	3804	775	86
Superphosphate**	1780	3398	777	92
Colloidal phosphate**	762	387	626	35
L.S.D. .05 1952	789	588	516	—

*Added at a rate of 60 lbs. P_2O_5 per acre except superphosphate and colloidal. Also received 120 lbs. N from ammonium nitrate and 60 lbs. of K_2O from muriate of potash.

**Superphosphate and colloidal phosphate added once at the rate of 666 pounds and 1000 pounds per acre, respectively. Both materials represented $8.25 worth of fertilizer at time of application.

[1] Check yields are total yields per acre; all others are increases over check.

of the experiment was randomized blocks with five replications.

Under the conditions of these 11 tests on limed soils, the relative yield values for the various phosphates based on the average increased yields from superphosphate as 100 follow: concentrated superphosphate 86, 40 mesh fused tricalcium phosphate 81, 10 mesh fused tricalcium phosphate 66, and rock phosphate (double rate of P_20_5) 61 (Table 21). The observed differences between ordinary superphosphate and concentrated superphosphate at Newton and Raymond were attributed to the sulfur in ordinary superphosphate.

These data show that on limed soils at Newton and Raymond concentrated superphosphate and 40 mesh fused tricalcium phosphate are about equally effective in increasing pasture yields. Within the limits of experimental error rock phosphate at double the P_20_5 rate of the other sources did as well at Raymond as 40 mesh fused tricalcium phosphate.

The tests just described have shown the results chiefly of experiments with processed phosphate materials. It has been suggested that rock phosphate, unprocessed except for grinding, may be a good source of phosphate under certain conditions. Recent shortages of sulfur have again focused attention on materials that are not dependent on sulfuric acid for their manufacture.

COLLOIDAL, ROCK, AND SUPERPHOSPHATE COMPARISONS

Over the past fifty years numerous experiments have been carried out to compare superphosphate with rock phosphate and closely allied materials. These studies have been made over a wide range of soil and crop conditions. Recent research along this line has included the mixing of superphosphate with rock phosphate or colloidal phosphate. Results of these experiments follow.

Rock Phosphate Experiments Before 1934

One of the older experiments comparing rock phosphate and superphosphate was conducted at Holly Springs from 1907 to 1913 using a cowpea, corn, cotton rotation on an acid Grenada silt loam (Table 22). The objective of the experiment was to determine the rate of P_20_5 in rock phosphate that was equal in crop producing efficiency to the conventional rate of P_20_5 (30 pounds per acre per year) from superphosphate. In addition to the phosphate, ten tons of stable manure were used over the seven year period. Cowpeas and vetch were the summer and winter legumes used in the rotation. Yields of cowpeas were taken but the vetch was plowed under as a green

Table 21. Effect of phosphorus sources applied at a 40 pound P_2O_5 rate each year on limed soils for the production of white clover-Dallis grass-lespedeza pasture.

P_2O_5 added at 40 lbs./A unless otherwise noted source of phosphorus***	Yield increases over check in lbs. pasture forage per A on:			Relative efficiency of phosphates. (Response to superphosphate = 100)			
	Sandy soil Newton 1948-50	Silt loam Raymond 1948-52	Clay Brooksville 1949-51	Newton	Raymond	Brooksville	Weighted average
Check, lime**	862 [1]	3329 [1]	1326 [1]	—	—	—	—
Suprephosphate plus lime	1121	1547	1336	100	100	100	100
Conc. superphosphate plus lime	859	1253	1371	77	81	103	86
Fused tricalcium phos. 40 M plus lime	832	1283	1126	74	83	85	81
Fused tricalcium phos. 10 M plus lime	695	749*	1326	62	48*	99	66
Rock phosphate (80 lb. P_2O_5) plus lime	496*	1211*	635*	44*	78*	48*	61

*These values are significantly less than superphosphate values.

**Limed to pH 6.0. 1700 lbs. lime at Newton; 2000 lbs. at Raymond; and 3000 lbs. at Brooksville.

***Annual applications. 50 lbs. of K_2O per acre also added annually.

[1] Check yields are total yields per acre; all others are increases over check.

manure crop. The yields of corn were excellent and the cotton and cowpea hay yields were fairly good. Relative to the phosphated plots, yields on the "no-phosphate" plots were low and good repsonse to phosphate was obtained. Conditions were such as are generaly associated with good crop response to rock phosphate namely: acid soil, manure, cover crops, high rate of rock phosphate, seven years of cropping, and legumes in the rotation.

In Table 22 it may be noted that during a seven year period 840 pounds of P_20_5 in rock phosphate (2800 pounds of 30 percent rock phosphate) produced an average annual yield of 10 pounds more cowpea hay, 3 bushels less corn, and 51 pounds less seed cotton than 210 pounds of P_20_5 in superphosphate (1313 pounds of 16 percent superphosphate). Thus it is evident that superphosphate was superior to the rock phosphate in producing corn and cotton even though the amount of P_20_5 supplied by rock phosphate was four times greater than that supplied by superphosphate. Where rock phosphate was added at double the rate of P_20_5 in superphosphate, cowpea hay production was 185 pounds less.

Superphosphate and Colloidal Phosphate for Corn: Comparisons of colloidal phosphate and superphosphate at 280 pounds per acre were made in Poplarville, McNeill, and Holly Springs from 1905 through 1924 (Table 23). In addition to the phosphates the plots received nitrogen in the form of cottonseed meal or sulphate of ammonia. The results of these experiments were averaged together and relative yield values calculated. Based on these 14 tests (4 years at Poplarville, 9 years at McNeill, and one year at Holly Springs), the relative yield values for corn are superphosphate 100; colloidal phosphate 50.

Rock Phosphate, Superphosphate, and Colloidal Phosphate for Cotton: An experiment was started in 1920 at Holly Springs to compare these materials under cotton (Table 24). The land had been in pasture for 14 years before the test was started. Nitrate of soda was added at the rate of 100 pounds per acre per year. The yields of cotton were exceptionally good and response to phosphate was clearly evident as shown by the check plot yields. Under the conditions of this five year test, with colloidal phosphate being added at more than twice the P_20_5 rate, and rock phosphate being added at almost four times the P_20_5 rate of superphosphate, the relative efficiency values were superphosphate 100, colloidal phosphate 58, and rock phosphate 54 (Table 24).

A similar experiment was conducted for five years from 1929 to 1934 at Holly Springs on Lintonia silt loam

Table 22. Comparison of superphosphate with double and quadruple rates of rock phosphate for four years under cotton, 2 years under corn, and one year under cowpeas at Holly Springs, 1907-1913.

Source of phosphorus*	Total P_2O_5 added per A	Average yield per acre per year: Cowpea hay	Corn	Seed cotton
	lb.	lb.	bu.	lb.
Superphosphate	210	1525	53	853
Rock phosphate	420	1340	45	678
Rock phosphate	840	1535	50	802
No phosphate	0	1180	39	385

*In addition to the phosphate 5 tons per acre of stable manure was broadcast on the land in the fall of 1906 and 1907. Hairy vetch was grown in 1909. Cowpeas were grown in 1908.

Table 23. Response of corn to colloidal phosphate and superphosphate at Poplarville, 1921-24, McNeill, 1905-1913, and Holly Springs, 1906.

Source of phosphorus*	Annual rate of P_2O_5 per A	Average yield per acre of corn	Increase per acre due to phosphate	Relative efficiency
	lb.	bu.	bu.	
None	0	20	—	—
Superphosphate	45	28	8	100
Colloidal phosphate	60	24	4	50

*In addition to the phosphorus each plot received annual applications of 280 lbs./acre cottonseed meal before 1923 and 105 pounds of sulfate of ammonia in 1924.

(Table 25). The experiment was not conducted in 1932. Each plot received in addition to the phosphate 36 pounds of nitrogen and 36 pounds of K_20. Under the conditions of this five year test, the relative yield values for the various phosphates based on the increased yield from superphosphate as 100 follow: rock phosphate 47 and colloidal phosphate 29.

Still another experiment was conducted at McNeill for eight years with cotton (Table 26). This test was designed to determine the relative efficiency of rock phosphate added at almost a double rate of P_20_5 compared to superphosphate. In addition to the phosphate, 100 pounds of cotton seed meal per acre was added. Under the conditions of this eight year cotton test, the relative yield values are: for the rock phosphate 67; for superphosphate 100 (Table 26).

Rock Phosphate, Basic Slag and Superphosphate for Cowpeas: This experiment was discussed before (Table 17) and is repeated here in order that all experiments involving rock phosphate conducted before 1934 may be included in this section. Under the conditions of this test from 1913 through 1915 where 200 pounds of each material was added annually to cowpeas, the relative yield values for the various phosphates based on the increased yield from superphosphate as 100 were as follows: basic slag 84, rock phosphate 70.

Rock Phosphate Experiments from 1934 to 1947

Rock Phosphate and Superphosphate for Cotton. The results of 97 tests with cotton conducted under a wide range of conditions from 1935 to 1939 were discussed before (Table 13). Equal amounts of P_20_5 from rock phosphate and superphosphate were used under cotton in these experiments and the relative efficiency values based on

Table 24. Response of cotton to colloidal phosphate, rock phosphate, and superphosphate at Holly Springs, 1920-24.

Source of phosphorus*	Total P_2O_5 added per A	Average yield per acre of seed cotton	Increase per acre due to phosphate	Relative efficiency
	lb.	lb.	lb.	
Superphosphate	160	1851	299	100
Colloidal phosphate	400	1725	173	58
Rock phosphate	600	1714	162	54
No phosphate	0	1552	—	—

*In addition to phosphate each plot received 100 pounds of nitrate of soda. The land on which this test was conducted had been in pasture for 14 years before this test was started. The phosphate materials were added annually at rates as follows: 200 pounds superphosphate, 400 pounds of rock and 400 pounds of colloidal phosphate.

Table 25. Response of cotton to colloidal phosphate, rock phosphate, and superphosphate at Holly Springs, 1929-34.*

Source of phosphorus**	Total P_2O_5 added per A	Average yield per acre of seed cotton	Increase per acre due to phosphate	Relative efficiency
	lb.	lb.	lb.	
Superphosphate	240	964	152	100
Rock phosphate	450	883	71	47
Colloidal phosphate	300	856	44	29
No phosphate	0	812	—	—

*Experiment was not conducted in 1932.

**Each plot including no phosphate check received 36 lbs. of nitrogen per acre from nitrate of soda and 36 pounds of K_2O per acre from muriate of potash. 300 lbs. of each phosphate material were added each year.

Table 26. Response of cotton to rock phosphate and superphosphate—McNeill Station, 1906-13.

Source of phosphorus*	Total P_2O_5 added per A	Average yield per acre of seed cotton	Increase per acre due to phosphate	Relative efficiency
	lb.	lb.	lb.	
None	0	359	—	—
Superphosphate	176	580	221	100
Rock phosphate	352	507	148	67

*In addition to phosphate each plot received 100 lbs. cottonseed meal. The superphosphate and rock phosphate were added annually at rates of 22 and 42 pounds of P_2O_5 per acre.

these 97 tests were superphosphate 100 and rock phosphate 48.

Colloidal Phosphate, Basic Slag, and Superphosphate for Pastures. This experiment has also been discussed before in connection with crop response of pastures to various phosphates (Table 18). It is re-emphasized here because colloidal was one of the phosphates used. Under the conditions of these 18 tests with pastures in which colloidal phosphate was added at double the rate of P_20_5 in superphosphate, the relative yield values for the various phosphates based on the increased yield from superphosphate as 100 follow: basic slag 112 and colloidal phosphate 58.

Rock Phosphate and Colloidal Phosphate Experiments After 1947

Rock Phosphate for Clover Pastures. Experiments were conducted from 1948 to 1951 at Newton on Prentiss fine sandy loam, at Raymond on Olivier silt loam, and at Brooksville on Hunt clay. The soil was limed to a pH of 6.0 to 6.5 at all locations. Rock phosphate was added at double the P_20_5 rate of the other sources. Other details of this experiment were described previously (Table 21). Rock phosphate treated plots produced more forage and the relative yield values were higher at Raymond on a silt loam soil than at the other locations. Here, it had a value of 78 in relation to the superphosphate value of 100. Based on superphosphate as 100, the relative yield values of rock phosphate, at double the P_20_5 rate of superphosphate were, at Newton 44, and at Brooksville 48. Based on a weighted average of these 11 pasture tests, the relative yield value for rock phosphate was 61 based on the increased yield from superphosphate as 100 (Table 21).

Colloidal Phosphate for Winter Oat Pastures. It has been suggested that, if a large amount, say 1000 pounds of colloidal phosphate, were added to the soil in one application, it would become available over a period of years and furnish needed phosphate to crops, particularly close growing crops such as oats. To test this assumption a treatment of 1000 pounds was included in sources of phosphate experiment. As a check, an amount of superphosphate equal in value to the 1000 pounds of colloidal phosphate was added to a plot adjoining the colloidal phosphate plot (Table 20). This test has been continued for three years at Newton, Tupelo, Brooksville, and Holly Springs. Based on the results of these 12 tests, with concentrated superphosphate added every year given a rating of 100, superphosphate had a relative yield value of 92 and colloidal phosphate 35 (Table 20). It is evident from 1953 field observations, other results not reported herein, and these data, that large amounts, say 1000 pounds of colloidal phosphate or 666 pounds of superphosphate, added once in three years will not produce as much forage as an equal amount of P_20_5 from superphosphate divided into three applications, and added in part each year.

Mixing Rock and Colloidal with Superphosphate for Fescue. This experiment was started at Brooksville in 1951 on a Hunt clay containing 7 pounds of dilute acid soluble P and having a pH of 5.7. The fertilizers were made up with phosphate from the various sources as indicated (Table 27). They were broadcast and disced into the upper five inches of soil. On one series of plots 606 pounds of P_20_5 from rock phosphate was added with 60 pounds of P_20_5 from superphosphate. On another, 606 pounds of P_20_5 from colloidal phosphate was added with 60 pounds of P_20_5 from superphosphate. Other treatments consisted of rock phosphate, colloidal phosphate, or superphosphate without mixing one with another. Rock phosphate and colloidal phosphate were added on unlimed plots, and on plots limed with one ton of dolomite. The field received a uniform application of 64 pounds of N from ammonium nitrate, 100 pounds of K_20 from muriate of potash, and 150 pounds of gypsum. There were four replications of each treatment in a randomized block design. The field was seeded to fescue and ladino clover. The ladino clover failed to survive but there was a good stand of fescue. Results are given in Table 27. It is planned to continue this test for ten years.

Results show that rock phosphate and colloidal phosphate produced more fescue forage on the unlimed plots (pH 5.7) than on the limed plots (pH 6.5). The two rates of superphosphate with lime ranked first and second in forage production. The rock phosphate mixed with superphosphate and the colloidal mixed with superphosphate ranked third and fourth in forage production. The rock phosphate and colloidal phosphate on unlimed soil ranked fifth and sixth while the rock phosphate and colloidal phosphate on limed soil produced little more herbage than the check plot.

Mixing Rock and Superphosphate for Wheat Pasture. This experiment was started at Raymond in 1952 on Olivier silt loam containing 8 pounds of dilute acid soluble P and having a pH of 5.0. The fertilizers were made up with phosphate from superphosphate, colloidal phosphate, and rock phosphate as indicated in Table 28. There were several rates of P_2O_5 from concentrated superphosphate and two rates of P_2O_5 from rock phosphate. Other treatments consisted of mixing rock phosphate or colloidal phosphate with 30 pounds of P_2O_5 from concentrated superphosphate. The fertilizers were mixed, added to the plots by hand, and disced into the surface 4 inches. The field received a uniform application of 60 pounds of N from ammonium nitrate, 100 pounds of K_2O from muriate of potash, and was limed to a pH of 6.0. Three clippings were made between the first week in January and the third week in February. After each clipping 60 pounds of N was added per acre. There were four replications of each treatment in a randomized block design. The data in Table 28 show the total yields for all three clippings for the winter period.

Table 27. The influence of mixing superphosphate with rock phosphate and with colloidal phosphate on the yields of fescue on Hunt clay (pH = 5.7)—Brooksville, 1952.

Source of phosphate*	Amount of P_2O_5 added lb./A	Forage yield lb./A	Rank
1. Superphosphate plus lime**	333	2850	1
2. Superphosphate plus lime	90	2057	2
3. Rock phosphate plus lime mixed with 60 lbs. of P_2O_5 from superphosphate	666	1751	3
4. Colloidal phosphate plus lime mixed with 60 lbs. of P_2O_5 from superphosphate	666	1441	4
5. Rock phosphate, no lime	666	1274	5
6. Colloidal phosphate, no lime	666	1163	6
7. Rock phosphate plus lime	666	901	7
8. Colloidal phosphate plus lime	666	789	8
9. Nothing	0	770	9

*Also received 64 pounds of N as ammonium nitrate and 100 pounds of K_2O.
**To pH 6.5 with all treatments except 5 and 6.

Table 28. The influence of mixing concentrated superphosphate with rock phosphate and with colloidal phosphate on the yield of winter wheat pasture on Olivier silt loam limed to pH 6.0.

Source of phosphate*	Pounds of P_2O_5 added per acre			Dry forage yield lb./A	Rank
	From rock or colloidal	From super-phosphate	Total added		
Conc. superphosphate	0	120	120	2244	1
Rock plus conc. super.	600	30	630	1953	2
Conc. superphosphate	0	60	60	1821	3
Colloidal plus conc. super.	300	30	330	1703	4
Colloidal plus conc. super.	600	30	630	1556	5
Ordinary 20 percent super.	0	60	60	1480	6
Rock phosphate	600	0	600	1472	7
Rock plus conc. super.	300	30	330	1225	8
Conc. superphosphate	0	30	30	1132	9
Rock phosphate	300	0	300	923	10
Conc. superphosphate	0	15	15	645	11
No phosphate	0	0	0	352	12
L.S.D. .05	—	—	—	300	—

*Also received 180 pounds of N as ammonium nitrate, 100 pounds of K_2O, and 150 pounds of gypsum per acre.

Concentrated superphosphate at a rate of 120 pounds of P_20_5 per acre ranked first in forage production. Rock phosphate at 600 pounds of P_20_5 per acre supplemented with 30 pounds of P_20_5 from concentrated superphosphate ranked second in forage production. Concentrated superphosphate at a rate of 60 pounds of P_20_5 ranked third in forage production, and colloidal phosphate at a rate of 300 pounds of P_20_5 mixed with 30 pounds of P_20_5 from concentrated superphosphate ranked fourth.

It is anticipated that several years' results of this experiment will be needed to fully evaluate the efficiency of the various sources and mixtures of sources. It is evident, however, from field observations and early clippings, that some water soluble P^20^5 is needed for maximum growth and earliness of production of winter grazing crops regardless of the amount of P_20_5 supplied from the non-water soluble sources such as rock phosphate or colloidal phosphate.

RESIDUAL EFFECT OF PHOSPHATE FERTILIZERS

Generally, only ten to fifteen percent of added phosphate fertilizer is recovered by the crop. Usually more is recovered from water soluble sources of phosphorus than from the more insoluble materials such as rock phosphate and tricalcium phosphate materials. But at best 70 to 85 percent of the phosphorus added as fertilizer is lost insofar as removed by the harvested portion of several crops is concerned. For this reason, studies have been undertaken in an attempt to improve on the efficiency of added phosphate fertilizer.

It has been suggested that the relative efficiency of the insoluble sources of phosphorus may be improved upon by longer contact with the soil. For this reason several long time tests have been conducted to determine the influence of time on the residual availability of insoluble sources of phosphorus.

The Residual Availability of Phosphates to Cotton. In 1935 experiments with various sources of phosphate were established at Smithville, Raymond, and West Point on Kalmia, Olivier, and Sumter soils, respectively (Table 29). The cotton was fertilized with 400 pounds of 4-8-4 from 1935 until 1939. From 1940 to 1944 phosphate and potash were not added, but 200 pounds per acre of $NaN0_3$ was added to each plot. The increased yield of cotton produced from 1940 to 1944 was taken as a measure of the residual availability of the various phosphates which were added from 1935 to 1939 in the 4-8-4 fertilizer. This 4-8-4 fertilizer was made up with sulfate of ammonia, muriate of potash, and phosphate from either superphosphate, concentrated superphosphate, dicalcium, tricalcium, rock phosphate, or basic slag. One treatment consisted of a 4-8-4 fertilizer, the nitrogen in which had been neutralized with 115 pounds of dolomite. In this fertilizer the source of phosphorus was concentrated superphosphate. It should be pointed out that 16 pounds of nitrogen were added in the 4-8-4 from 1935-39 and 32 pounds of nitrogen were added as nitrate of soda from 1940-44. The fertilizers were added in the furrow and covered with a "middle buster" plow. There were four systematic replications of each treatment.

Under the conditions of these 30 tests (10 years at three locations) with cotton, the relative yield values for the various residual phosphates based on the increased yield from residual superphosphate as 100 follow: concentrated superphosphate plus lime 156, dicalcium phosphate 131, tricalcium phosphate 116, basic slag 116, concentrated superphosphate 98, and rock phosphate 50 (Table 29).

It is interesting to note that concentrated superphosphate with no lime ranked next to last but with lime it ranked first. This emphasizes that measurements of different sources of phosphate as indicated by crop yields should not be made on very acid soils, because the results of this experiment and several others have indicated that the yield increases obtained were, to some extent at least, influenced by the calcium content of the various phos-

Table 29. The residual availability of various sources of phosphorus as **measured by increased yields of seed cotton fertilized with 400 pounds of 4-8-4 per acre annually for the five years (1935-39), and** 200 **pounds of nitrate of soda alone for each of the five years (1940-44).**

Source of phosphorus in the 4-8-4	Yield increase over check lb./A								Relative efficiency of phosphorus sources (Super = 100)	
	Smithville sandy soil		Raymond silt loam		West Point clay soil		Average of 3 locations			
	1935-39	residual 1940-44	1935-39	residual 1940-44	1935-39	residual 1940-44	1935-39	residual 1940-44	1935-39	residual 1940-44
Check	632	662	1093	1234	582	513	769	803	rating	rating
Superphosphate	94	105	132	89	42	141	89	112	100	100
Conc. superphosphate	60	64	55	114	29	151	48	110	54	98
Dicalcium phosphate	35	70	84	205	42	167	54	147	61	131
Tricalcium phosphate	72	107	59	281	21	—1	51	130	57	116
Rock phosphate	—17	99	71	63	—38	6	3	56	3	50
Basic slag	150	194	122	16	83	179	118	130	133	116
Conc. super plus lime*	204	181	53	193	20	151	92	175	103	156

*Dolomite at the rate of 115 pounds per year from 1935 to neutralize the acidity of the sulfate of ammonia which was the source of nitrogen in the 4-8-4.

phate fertilizers, and the pH of the soil. If measurements of phosphate availability by crops are to reflect accurately the availability of the phosphate in the fertilizer, then phosphate should be the only limiting factor in the growth of the plant.

These results (Table 29) showed that the residual phosphate and potash remaining in the soil were utilized by the cotton plants. Also the relative efficiency of the insoluble sources of phosphate were increased with time. However, the relative efficiency of concentrated superphosphate also increased with time. The spread between the residual efficiency of superphosphate and rock phosphate was of the order of 2 to 1. It should be pointed out that calculations based on the amount of phosphate in seed cotton indicate that over a ten-year period the combined yields of cotton on the best plots removed from the soil only 20 percent of the fertilizer phosphate. In this calculation it was assumed that no native soil phosphate was released to the crop. This implies that over 80 percent of the fertilizer phosphate remained in the soil or was lost by erosion.

Residual Availability of Superphosphate for Pasture. In 1941 an experiment was established at the North Mississippi Branch Experiment Station at Holly Springs on Grenada silt loam. The objective was to determine the residual availability of superphosphate for pastures over a five-year period. Plots were laid out and the fertilizer was broadcast on top of an existing hop, white clover, lespedeza, bermuda grass pasture. One series of plots received no phosphate; another series received 80 pounds of P_20_5 in 1940, and still another was fertilized with 80 pounds of P_20_5 in 1940, '41, '42, '43, and '44, (Table 30).

One application of superphosphate in 1940 increased the pasture yields for four years. Furthermore, the legume population increased from 15 percent the first year to 45 percent the fifth year. The forage yield was doubled the first year by the 80 pound P_20_5 rate. With no additional phosphate the yield gains progressively decreased after 1942 until the last year when there was no further increase from the added phosphate. Annual applications of 80 pounds of P_20_5 continued to show marked increases in yield every year for five years and results show that the average for the five-year period was almost double the average yields on the check plots (Table 30). The plots receiving the annual application of 80 pounds of P_20_5 per acre had a plant population consisting of 80 percent legumes at the end of the five years.

Chemical analysis of the forage showed that during the five-year period 72 pounds of P_20_5 were taken up by the plants on the no-phosphate plots, 98 pounds were taken up by the plants on the plots treated with 80 pounds of P_20_5 in 1940, and 140 pounds of P_20_5 were taken up by the plants on the plots fertilized with 80 pounds of P_20_5 each year. If it is assumed that the plants on the treated plots took up the same amount of P_20_5 from the native supply in the soil as was found in the forage produced on the no-phosphate plots, then the 80 pounds P_20_5 treatment in 1940 contributed 26 pounds of P_20_5 to the forage, and the 80 pound P_20_5 treatment every year contributed 68 pounds of P_20_5 to the forage. The percent recovery of the added phosphate in the first case was 32.5 percent and the percent recovery of the added phosphate in the second case was 17.0 percent.

It is concluded that the efficiency of the phosphate is increased by increasing the length of time it is in contact with growing plant roots. However, if good forage yields are desired each year, annual applications are necessary.

Table 30. Residual availability of superphosphate as measured by yields of bermuda grass, white clover pasture fertilized with 400 pounds of superphosphate once in five years compared to 400 pounds added annually. Holly Springs.

P_2O_5 lb./A	Pounds forage produced per year					Average
	1941	1942	1943	1944	1945	
0	1763	3912	3578	3691	2900	3097
80 in 1940	3097	6225	4400	4495	3030	4249
80 every year	3097	8787	5769	7121	5535	6062

The profit gained by improving on the efficiency of the phosphate was small compared to the value of the forage produced on the plots fertilized each year with 80 pounds of P_20_5.

PHOSPHATE IN HIGH ANALYSIS FERTILIZER

In recent years there has been a trend toward the production and use of high analysis fertilizers such as a 13-13-13. Widely scattered experiments have indicated that these materials do as well on limed soils as the lower analysis materials such as a 7-7-7. Fertilizers analyzing as high as a 15-15-15 have been produced on a small scale but this material did not contain sulfur. The high analysis fertilizers on the market today contain 10 to 25 percent SO_3 depending on the method of manufacture. Usually these high analysis fertilizers are manufactured using one of the following materials: nitric phosphate, ammonium phosphate, or ammoniated superphosphate. There is considerable flexibility in the manufacture of these materials and by modification the phosphate may be made more or less water soluble, the calcium content may be low or high, and the sulfur content may be varied considerably. All of these factors influence the efficiency of a fertilizer. Space does not permit a detailed discussion of fertilizer technology. However, a brief description of the three materials from which present day high analysis fertilizers are made would be in order.

Description of Materials

In order to show the various elements present in the fertilizer materials, typical chemical analyses of each high analysis fertilizer used in these experiments are shown in Table 31. The percent composition of N, K_20, CaO, $S0_3$, $C1_2$, and total, available, and water soluble P_20_5 is included along with the A.O.A.C. acidity in pounds of $CaC0_3$, equivalent per ton.

Nitric Phosphate. This material is made by mixing nitric acid with rock phosphate. In some processes, such as that used to produce the 11-11-11 fertilizer described in Table 31, a mixture of nitric and sulfuric acids is added to rock phosphate. Ammonia and muriate of potash are then added to the slurry and the resultant product dried and ground. About one-fifth of the P_20_5 in this mixture is water soluble.

Ammoniated Superphosphate. This is prepared by adding anhydrous ammonia to concentrated or ordinary 20 percent superphosphate. The ammoniation may be carried out in a drum-type ammoniator. The 10-10-10 fertilizer described in Table 31 was made from 18.5 percent superphosphate and contained about 64 pounds of ammonia per ton. By adding the ammonia slowly to prevent overheating very little loss of citrate solubility of P_20_5 resulted. However, only about one-fifth of the P_20_5 in the fertilizer remains water soluble.

Ammonium Phosphate. Liquid phosphoric acid, made from rock phosphate, is mixed with sulfuric acid and the mixed acids are combined with ammonia to form ammonium phosphate. To this slurry is then added muriate of potash and a small amount of manure salts and nitrate of soda. The resulting product is dried in a rotary kiln and the 13-13-13 fertilizer, such as that described in Table 31, comes out as hard pellets. The P_20_5 in this material is almost all water soluble, but very little calcium is contained in the final mixture.

Cotton Response to High Analysis Fertilizer

This experiment was started in 1950 at Newton, Brooksville, Holly Springs, and Raymond on Prentiss fine sandy loam, Hunt clay, Grenada silt loam, and Olivier silt loam, respectively (Table 32). All of the soils had a pH of less than 5.5 except the Hunt clay which had a pH of 6.2. The dilute acid soluble phosphorus in the soils were as follows: Newton 5 lbs./A, Brooksville 17 lbs./A, Holly Springs 17 lbs./A, and Raymond 11 lbs./A. Response to phosphate at odds 19:1 were obtained at all locations. The tests have been conducted for three years (1950-52) at Newton,

Table 31. **Chemical analyses of materials used in "high analysis" fertilizer tests with cotton and oats.**

Fertilizers	Typical Chemical Analysis in Percent								A.O.A.C. acidity lb. $CaCO_3$/ton
	Total N	P_2O_5			K_2O	CaO	SO_3	Cl_2	
		Total	Avail-able	Water soluble					
11-11-11 nitric phosphate	11.5	11.9	11.4	2.1	11.1	17.6	10.1	8.4	—158
14-14-14 nitric phosphate	14.3	14.7	14.3	0.7	14.9	12.9	0.5	11.4	—574
17-22-0 nitric phosphate	17.8	21.9	21.7	3.3	0	15.7	0	0	—350
12-33-0 nitric phosphate	12.4	34.6	31.2	14.5	0	19.8	0	0	—385
10-10-10 ammoniated superphosphate	10.0	10.9	9.7	2.2	10.5	14.6	28.0	7.3	—446
13-13-13 ammonium phosphate	13.1	13.5	13.0	12.9	13.0	2.8	18.3	5.2	—570

Table 32. **Cotton response to nitric phosphate, ammoniated superphosphate, and ammonium phosphate in "high analysis" fertilizers.**

Analysis and description of fertilizers added at a rate of 40 lbs. N, 40 lbs. P_2O_5, and 40 lbs. K_2O	Yield increases over check in lbs. of seed cotton per acre at:				Relative efficiency of fertilizers. (Response to conc. super = 100) rating
	Newton 1950-52	Brooksville 1950-52	Holly Springs 1950-52	Raymond 1951	
10-0-10 check, no phosphate	407[1]	87	794	824	—
9-9-9 same as 11-11-11 40 M with lime	901	544	254	792	121
11-11-11 40 M* nitric phos. with sulfur	935	586	222	600	120
10-10-10 ammoniated superphos. with sulfur	788	527	215	392	103
14-14-14 nitric phos. without sulfur	774	518	181	488	101
11-11-11 10 M* nitric phos. with sulfur	763	453	181	616	99
13-13-13 ammonium phos. with sulfur	720	551	175	440	99
15-15-15** nitric phos., low H_2O Sol. P.	780	475	127	600	98
15-15-15** nitric phos., high H_2O Sol. P.	673	568	82	672	96
7-7-7 same as 10-10-10 with lime	737	392	240	576	96
Conc. superphos. plus 40 lbs. N and 40 lbs. K_2O	854	578	126	184	100
L. S. D. .05	81***	174	81***	241	—

*40 M means ground to pass a 40 mesh screen; 10 M means ground to pass a 10 mesh screen.

**No sulfur. Base of low water Sol. P. was 17-23-0; base of high water Sol. P. was 12-33-0. Supplements—NH_4NO_3 and KCl. See Table 31 for chemical analysis of fertilizers.

***Newton and Holly Springs yields analyzed together.

[1] Check yields are total yields per acre. All others are increases over the check.

Brooksville, and Holly Springs, and for one year (1951) at Raymond. The fertilizers, at a rate equivalent to 400 pounds of 10-10-10 per acre, were banded by hand in the row middles and covered with a mold board plow. The experiments were arranged in randomized blocks with six to eight replications.

Under the conditions of these ten tests, relative yield values of the various fertilizers, based on the increased yield of cotton from a mixture containing concentrated superphosphate as 100 are as follow: 10-10-10, ammoniated superphosphate 103; 14-14-14, nitric phosphate 101; and 13-13-13, ammonium phosphate 99. A nitric phosphate with sulfur (11-11-11) produced the highest yields and was rated 120. The 7-7-7, a neutral fertilizer, produced a very low yield at Brooksville, because the high calcium content of the soil at that location undoubtedly caused some reduction of availability of the phosphate in the ammoniated superphosphate from which the 7-7-7 was made. At the other locations this material produced as well as some of the other fertilizers. The better cotton yield increases obtained with nitric phosphates containing calcium and sulfur, indicates that these materials are at least equal to the crop producing efficiency of ammonium phosphate and ammoniated superphosphate.

Winter Oat Pasture Response to High Analysis Fertilizers

In 1950 experiments were established at Newton, Tupelo, Brooksville, and Holly Springs on Prentiss, Tilden, Hunt, and Grenada soils, respectively (Table 33). These soils contained less than seven pounds of dilute acid soluble phosphorus except the Grenada soil which contained 13 pounds. The pH of the soil varied from 4.9 to 5.1 except for the Hunt clay which had a pH of 6.8. The fertilizers, at a rate equivalent to 600 pounds of 10-10-10 per acre, were broadcast in the fall on top of the ground by hand and disced in lightly. An additional 60 pounds of N was top dressed after the first harvest of forage. No lime was added. The experiments were arranged in randomized blocks with four replications. Response to phosphate at odds 19:1 were obtained at all locations.

Under the conditions of these nine tests with winter oat pastures, the relative yield values of the various fertilizers, based on the increased yield of oat forage from a mixture containing concentrated superphosphate as 100, are as follows: 14-14-14, nitric phosphate 100; 13-13-13, ammonium phosphate 98; 10-10-10, ammoniated superphosphate 85. The latter material produced a low yield at Brooksville probably because the high calcium content of the soil at that location reduced the availability of the phosphorus in the ammoniated superphosphate (Table 33). The results show that the nitric phosphates are at least as good as ammonium phosphate and ammoniated superphosphate for winter oats.

These tests with winter oat pastures were conducted so that a measure of the earliness of growth, as influenced by the various fertilizers, could be obtained. The data in Table 33 are average results for the full years' production. Space does not permit a discussion or tabulation of the data by clippings here, but it should be mentioned that the early winter oat pastures treated with fertilizers containing a high content of water soluble phosphorus such as that in the 13-13-13 ammo-phos produced higher yields and could carry more animals in the winter than those pastures fertilized with water-insoluble phosphate fertilizers.

Table 33. Winter oat pasture response to nitric phosphate, ammoniated superphosphate, and ammonium phosphate in "high analysis" fertilizers.

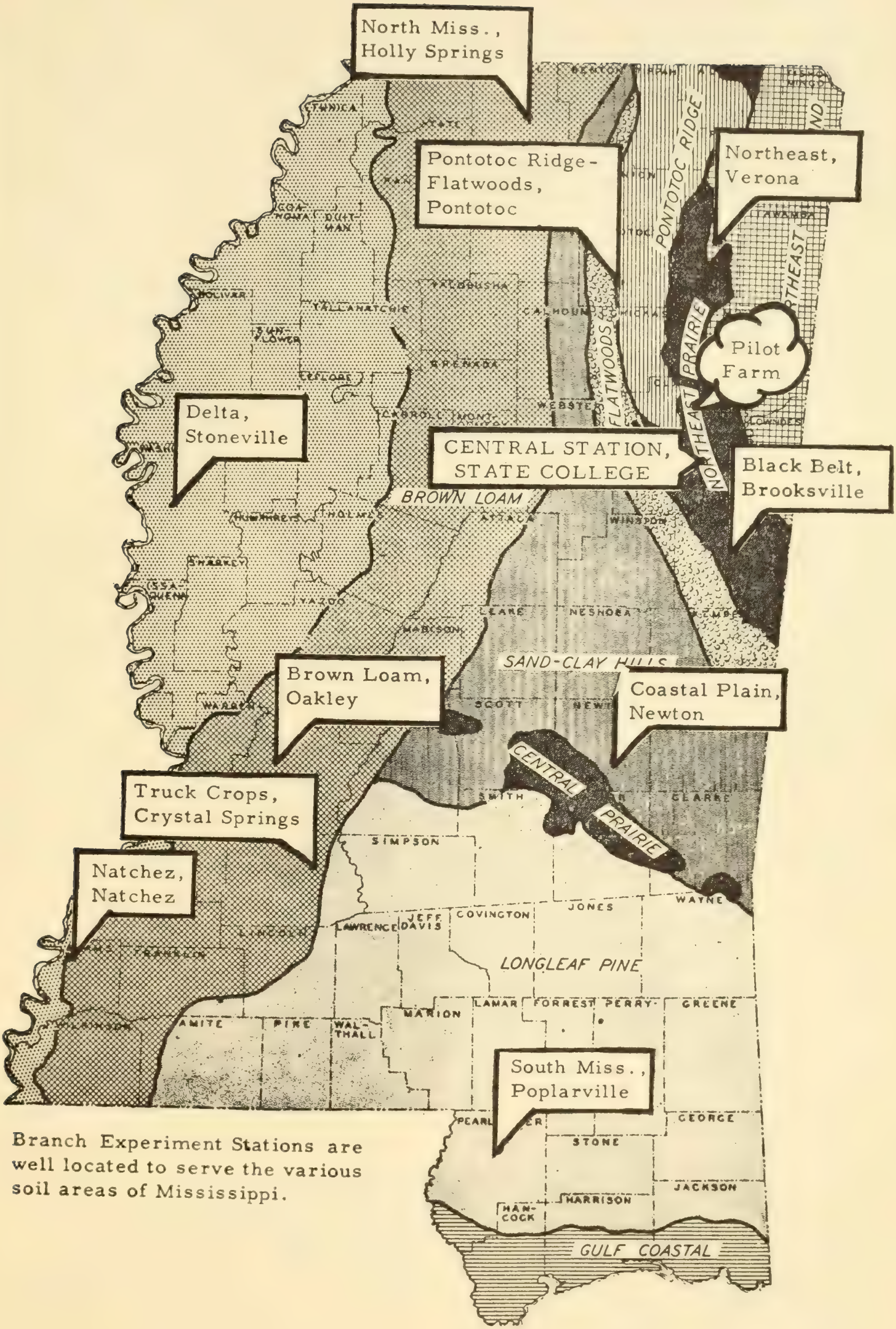
Analysis and description of fertilizers added at a rate of 60 lbs. N,* 60 lbs. of P_2O_5, and 60 lbs. K_2O	Yield increases over check in lbs. of oats forage per acre at:				Relative efficiency of fertilizers. (Response to conc. super = 100) rating
	Newton 1950-52	Tupelo 1951-52	Brooksville 1952	Holly Springs 1951-52	
10-0-10 check, no phosphate	1114[1]	2162	1401	3276	—
15-15-15** nitric phos, high H_2O Sol. P.	2040	2457	3522	987	103
11-11-11 nitric phos. with sulfur	2189	2233***	3572	931	103
14-14-14 nitric phos. without sulfur	2071	2382	3437	765	100
15-15-15** nitric phos. high H_2O Sol. P.	2025	2195	3456	919	99
13-13-13 ammonium phos. with sulfur	1573	2040	4450	1183	98
10-10-10 ammoniated superphos. with sulfur	1628	2113	2980	770	85
Conc. superphos. plus 60 lbs. N and 60 lbs. K_2O	2050	2398	3622	699	100
L. S. D. .05 1952	789	995	588	516	—

*Oats were top dressed in February with an additional 60 pounds of nitrogen.

**No sulfur. Base mixture of high water soluble P was 12-33-0; that of low water soluble P, 17-23-0. Supplements were NH_4NO_3 and concentrated superphosphate. See table 31 for chemical analysis.

***Calculated yield.

[1] Check yields are total yields per acre. All others are increases over the check.


North Miss., Holly Springs
Pontotoc Ridge-Flatwoods, Pontotoc
Northeast, Verona
Pilot Farm
Delta, Stoneville
CENTRAL STATION, STATE COLLEGE
Black Belt, Brooksville
Brown Loam, Oakley
Coastal Plain, Newton
Truck Crops, Crystal Springs
Natchez, Natchez
South Miss., Poplarville
BROWN LOAM
SAND-CLAY HILLS
PONTOTOC RIDGE
FLATWOODS
NORTHEAST PRAIRIE
CENTRAL PRAIRIE
LONGLEAF PINE
GULF COASTAL
TUNICA
COAHOMA
QUITMAN
BOLIVAR
TALLAHATCHIE
SUNFLOWER
LEFLORE
YALOBUSHA
CALHOUN
GRENADA
CARROLL
WEBSTER
HUMPHREYS
HOLMES
ATTALA
WINSTON
SHARKEY
ISSAQUENA
YAZOO
LEAKE
NESHOBA
MADISON
WARREN
SCOTT
SMITH
CLARKE
SIMPSON
JONES
WAYNE
COVINGTON
JEFF DAVIS
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WILKINSON
AMITE
PIKE
WALTHALL
MARION
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BULLETIN 504 AUGUST 1953

MILO AS FEED FOR FATTENING PIGS

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

MILO AS FEED FOR FATTENING PIGS

By J. L. FLETCHER

In recent years, tremendous interest has developed in Mississippi in the growing of winter oats and other small grains, both for winter grazing and for grain. Where grain is harvested from these crops, the land is in use at least until early June and often considerably later. This generally is too late for growing a satisfactory corn crop. This situation led, in a number of cases, to the practice of seeding combine milo after harvest of the winter grain.

The combination of winter grain and combine milo offers certain advantages. Both of these crops can be handled with the same seeding and harvesting equipment. Also the milo can be harvested early enough in the fall to return the land to winter grain, especially where the winter grain is harvested rather than used for grazing.

Various grain type sorghums have been grown extensively in other sections and numerous feeding trials have been conducted with them. However, Mississippi farmers in general have not had extensive experience with this type of grain nor have the feeding results obtained in other areas been uniform. As a result of this situation, a series of feeding trials with fattening pigs was initiated at the Mississippi Experiment Station and during the period of 1947 to 1952, six such trials were conducted. Since each of these was somewhat different from the others in the series, each trial is presented as a separate unit in this report.

Trial I

In this preliminary trial, as in all later ones, Martin's combine milo grown on the station farm was used in the ration. Two lots of ten pigs each were used in this test. Lot I, the check lot, received a concentrate mixture of 90 pounds of ground corn, 5 pounds tankage, and 5 pounds cottonseed meal. Lot 2 was fed a mixture of 45 pounds of ground corn, 45 pounds ground milo, 5 pounds tankage and 5 pounds cottonseed meal. Salt was added to both feed mixtures at the rate of ½ pound per 100 pounds of feed. Both lots were self-fed while grazing green oat forage.

The results of this test are summarized in Table 1 which shows that both lots of pigs made quite satisfactory gains. The pigs fed the milo required somewhat more feed to produce 100 pounds of gain than did the pigs in the check lot.

Due to the greater daily gains of the check lot pigs, 2.1 pounds as compared to 1.83 pounds on the milo ration, this lot was carrying a little more finish at the end of the test. However, the two lots of pigs were sold as a group and all brought the same price per pound.

Trial II

This was a more extensive trial conducted during the late winter and spring of 1948. Included in the trial were four lots of eight pigs each. In the check lot (Lot I) the feed mixture was 90 pounds ground corn and 10 pounds tankage. Lot 2 received a mixture of 90 pounds ground milo and 10 pounds tankage. For Lot 3, the feed mixture was 30 pounds milo, 60 pounds corn and 10 pounds tankage. The fourth lot was fed a mixture of 45 pounds corn, 45 pounds milo and 10 pounds tankage. In this trial, ¼ pound of salt was added to each 100 pounds of feed mixture for all lots and pigs were self-fed while grazing green oat forage.

Duroc, Poland China and Duroc-Poland crossbred pigs from the Experiment Station herd were used in the test. The average initial weight was about 65 pounds. In order to avoid feeding heavy weight pigs, each was removed from the test as near as possible to 200 pounds in liveweight.

Table 2 shows the results of this trial. As was the case in the previous trial, all lots made quite satisfactory gain. One of the most striking features of the test was that the lowest average daily gain, 1.76 pounds, was made by the check lot pigs receiving the corn and tankage ration. This might reflect the slightly lower protein content of the Lot I feed mixture which was due to the lower crude protein content of the corn than of the milo grain.

At the start of the feeding period pigs in Lots 2 and 3 receiving large amounts of milo did not particularly relish their feed. However, after a few days, they ate it quite readily. This was particu-

Table 1. Milo for fattening pigs, March 6 to May 14, 1947.

Lot	1	2
Feed Mixture	Corn—90 lbs. Tankage—5 lbs. Cottonseed meal—5 lbs.	Corn—45 lbs. Milo—45 lbs. Tankage—5 lbs. Cottonseed meal—5 lbs.
No. of pigs	10	10
Days on feed	69	69
Av. initial wt. lbs.	62.7	64.0
Av. final wt. lbs.	207.7	190.6
Av. gain lbs.	145.0	126.6
Av. daily gain lbs.	2.10	1.83
FEED PER 100 LBS. GAIN		
corn	303.7	164.6
milo	——	164.6
tankage	16.8	18.2
cottonseed meal	16.8	18.2
Total	337.3	365.6
Relative efficiency %	100	92

Table 2. Milo as a substitute for corn for fattening pigs, Feb. 19 to May 12, 1948.

Lot	1	2	3	4
Ration	Corn—90 lbs. Tankage—10 lbs.	Milo—90 lbs. Tankage—10 lbs	Corn—30 lbs. Milo—60 lbs. Tankage—10 lbs	Corn—45 lbs. Milo—45 lbs. Tankage—10 lbs.
Number of pigs	8	8	8	8
Av. initial wt.	64.5	63.8	63.9	64.7
Av. final weight	192.2	199.7	205.5	203.7
Av. gain	127.7	135.9	141.6	139.0
Av. no. days on test	72.3	73.6	73.2	70.0
Av. daily gain	1.76	1.88	1.93	1.98
FEED PER 100 POUNDS GAIN				
Corn	319.23	--------	120.48	159.43
Milo	--------	327.78	240.96	159.43
Tankage	35.47	36.42	40.16	35.43
Total	354.7	364.2	401.6	354.3
Relative efficiency %	100	97	88	100

Table 3. Milo as a substitute for corn for fattening pigs, March 11 to May 20, 1949.

Lot	1	2	3	4	5
Ration (1)	Corn—90 lbs. Tankage—5 lbs. CSM—5 lbs.	Milo—90 lbs. Tankage—5 lbs. CSM—5 lbs.	Whole Milo and Supplement of ½ tankage and ½ CSM fed free choice	Corn—30 lbs. Milo—60 lbs. Tankage—5 lbs. CSM—5 lbs.	Corn—45 lbs. Milo—45 lbs. Tankage—5 lbs. CSM—5 lbs.
No. of pigs	10	10	10	10	10
Av. initial wt.	83.3	83.2	83.4	83.2	83.3
Av. final wt.	198.6	201.6	187.2	201.4	205.0
Av. gain	115.3	118.4	103.8	118.2	121.7
Av. daily gain	1.77	1.79	1.52	1.81	1.84
FEED PER 100 POUNDS GAIN					
Corn	358.0	00	00	133.2	196.0
Milo	----	372.6	431.7	266.4	196.0
Tankage	20.0	20.6	22.4	22.2	21.7
Cottonseed meal	20.0	20.6	22.4	22.2	21.7
Total	398.0	413.8	476.5	444.0	435.4
Relative Efficiency %	100	96	83	89	91

(1) ½% salt added to mixtures in lots 1, 2, 4 and 5.
10 lbs. salt added to each 100 lbs. supplement fed in Lot 3.

larly true in Lot 2 in which milo was the only grain in the mixture.

Feed required to produce 100 pounds of gain was essentially the same for Lots 1, 2 and 4 and only in Lot 3 was there a marked difference. The approximately 40 pounds more feed required in Lot 3 than in Lot 1 was significant. The greater feed requirement in Lot 3 could have been caused either by less abundant forage in the lot or a greater wastage of feed. Both appeared to prevail in Lot 3.

Trial III

Trial III involved five lots of 10 pigs each and all were self-fed while grazing on green oat forage. In this trial, cottonseed meal was used as replacement for one-half the tankage in all rations. Again the Lot mixture, 90 pounds of ground corn, 5 pounds of tankage and 5 pounds of cottonseed meal, served as the check. In Lot 2, corn was replaced by ground milo. Lot 3 was self-fed whole milo and the protein-supplement free choice. The mixture for Lot 4 was 30 pounds corn, 60 pounds ground milo, 5 pounds tankage and 5 pounds cottonseed meal. In Lot 5, the mixture was 45 pounds ground corn, 45 pounds ground milo, 5 pounds tankage and 5 pounds cottonseed meal.

Results of this trial are presented in summarized form in Table 3. The daily rate of gain was quite similar for all lots except 3. The daily gain in this lot, in which whole milo was fed, was 1.52 pounds while in Lot 1 it was 1.77 pounds. As in Trial II, the check lot daily gain was slightly less than the lots in which ground milo was fed. However, this difference was very slight and not significant.

Feed consumed per pound of gain was less favorable than in previous trials in all lots. The feed requirement in Lot 3 was significantly higher than in any of the other lots. Approximately 75 pounds more feed was required per 100 pounds gain in Lot 3 than in Lot 1.

There was marked difference in the closeness of grazing in the various lots. Forage in Lot 1 was grazed much more closely than in Lot 2. Lots 4 and 5 tended to show that as the percent corn in the mixture increased, the amount of forage consumed also increased. The differences in grazing may have been caused by the differences in protein content of the rations. Rations containing larger quantities of milo were slightly higher in protein content than were those in which corn furnished all or most of the grain. The corn used in this trial contained 9.25 percent crude protein while the milo contained 13.69 percent. Table 4 shows the crude protein content of the corn and milo grain used in this 1949 trial and also of grain used in other trials.

Table 4. Crude protein content of corn and milo grain in various years.

Year	Corn	Milo
	%	%
1947 (1946 crop)	10.50	9.69
1949 (1948 crop)	9.25	13.69
1950 (1949 crop)	8.31	15.81
1951 (1950 crop)	8.19	12.38
1952 (1951 crop)	9.13	12.44

Trial IV

In the spring of 1950, a trial involving three lots of pigs was conducted. Rations in Lots 1 and 2 were similar to those fed in Lots 1 and 2 of the previous year. The feed mixture in Lot 1 was 90 pounds of corn and 10 pounds of tankage, and in Lot 2 a combination of 90 pounds milo and 10 pounds tankage was provided. The third lot, Lot 3, received a mixture of 75 pounds corn and 25 pounds tankage. The mixture in Lot 3 contained the same percent of crude protein as the milo-tankage mixture fed in Lot 2.

Table 5 gives a summary of the results of this trial. The daily gains for Lots 2 and 3 were almost identical, being 1.73 and 1.72 pounds respectively. This was about .2 of a pound per day greater than the gain of 1.54 pounds in Lot I. It appeared that higher protein content of the ration in Lots 2 and 3 was of value in increasing gains. However, gains were more economical in Lot 1. It might also be noted that the much greater consumption of expensive tankage in Lot 3 made the cost of gains considerably greater in this lot.

Use of cage clippings failed to show any differences in forage consumption in the three lots.

Trial V

This trial was considerably shorter than the previous ones. The feeding period was only 60 days and the average gain made per pig was only slightly more than 50 pounds. Five lots of 10 pigs were involved. The feeds for the different lots were as follows:

Lot 1: ground corn 90 pounds, cottonseed meal 5 pounds, tankage 5 pounds.

Lot 2: ground milo 90 pounds, cottonseed meal 5 pounds, tankage 5 pounds.

Lot 3: shelled corn and supplement free choice.

Lot 4: ground milo and supplement free choice.

Table 5. Milo as a substitute for corn, March 20 to May 29, 1950.

LOT	17	18	19
Ration (1)	Corn—90 Tankage—10	Milo—90 Tankage—10	Corn—75 Tankage—25
No. of pigs	7	7	7
Av. initial wt.	73.8	84.1	74.2
Av. final wt.	182.0	195.4	194.0
Av. gain	108.2	121.3	119.8
Av. daily gain	1.54	1.73	1.72
FEED PER 100 LBS. GAIN			
corn	355.5	------	321.8
milo	------	381.6	------
tankage	39.5	42.4	107.2
Total	395.0	424.0	429.0
Relative efficiency %	100	93	92

(1) 0.5% salt added to all mixtures.
All lots grazed oat forage.

Lot 5: ground corn 82 pounds, tankage 9 pounds, cottonseed meal 9 pounds.

The supplement in Lots 3 and 4 was composed of equal parts of tankage and cottonseed meal. All lots grazed oat forage. The larger amounts of the protein feeds in Lot 5 were used to provide a mixture with a crude protein content similar to that of the milo mixture in Lot 2.

In Table 6 the results of this trial are summarized. Gains were lower in Lot 2 than in the other lots which was considerably different from results in previous trials. The data on feed requirements shows very poor feed utilization in all lots.

Trial VI

This was the final feeding trial in this study. The rations used were quite similar to the 5 used in Trial V. For this trial, tankage alone was used as the protein supplement. Some changes were made in the procedure in this trial. Two replicates of the five treatments were conducted. In each replicate only two pigs were fed per lot. The results of the two replicates are combined in Table 7.

As in the previous trial, the mixture of 90 pounds of milo and 10 pounds of supplement produced the lowest daily gain. Unlike the results secured in earlier trials, there did not appear to be any advantage to increasing the amount of protein supplement fed with the corn. This is indicated by the very slight difference in rate of gain between Lots 1 and 5.

With the exception of Lot 3 in which shelled corn and tankage were fed free choice, none of the lots made very satisfactory use of the feed in producing gain. As shown in Table 7, Lot 2 which received the milo-tankage mixture required 603 pounds of feed per 100 pounds of gain. This was decidedly more than would be expected under most conditions. The most efficient lot was Lot 3 in which only 390 pounds of feed was required per 100 pounds of gain.

Summary and Conclusions

A series of six trials were conducted to compare the feeding value of milo grain and corn in fattening pigs. Results of the tests were quite favorable to milo. In these trials, the substitution of milo for corn on a pound for pound basis resulted in equal or slightly more rapid gains, and milo rations were only slightly less efficient than corn rations. In these trials, ground milo rations were 92 percent or more as efficient as the corn-tankage check ration.

The earlier trials indicated that the higher protein content of milo as compared to corn made it possible to provide a satisfactory ration with the use of less protein supplement. This did not appear to be quite so apparent in later trials.

In a single trial, less favorable results were secured with whole grain milo than with ground milo grain. Whole milo fed free choice resulted in a ration only 83 percent as efficient as the corn-tankage control.

More satisfactory results were secured from milo when fed free choice than when fed in a mixed ration. Also quite good results were secured by replacing one half the corn of a mixed ration with ground milo. This mixture was approximately 94 percent as efficient as the corn-tankage ration.

Table 6. Milo vs. corn for growing pigs, January 18, 1951 to March 19, 1951.

Lot	1	2	3	4	5
Ration	Corn 90 CSM 5 Tankage 5 Salt ½	Milo 90 CSM 5 Tankage 5 Salt ½	Shelled Corn Supplement (1) Free-Choice	Ground Milo Supplement (1) Free-Choice	Corn 82 Tankage 9 CSM 9 Salt ½
Percent Protein of Feed Consumed	11.87	15.64	12.24	16.12	14.92
No. of pigs	10	10	10	10	10
Av. days on feed	60	60	60	60	60
Av. initial weight	73.2	72.3	72.7	72.1	74.3
Av. final weight	128.5	118.9	136.2	127.9	135.1
Av. gain	55.3	46.6	63.5	55.8	60.8
Av. daily gain	.92	.77	1.06	.93	1.01
FEED PER 100 LBS. GAIN					
Corn	553.5	-------	456.0	-------	444.4
Milo	-------	615.6	-------	500.0	-------
Tankage	30.75	34.2	28.5	32.5	48.8
Cottonseed meal	30.75	34.2	28.5	32.5	48.8
Total	615.0	684.0	513.0	564.0	542.0
Relative efficiency %	100	88	119	109	111

(1) Supplement: ½ tankage, ½ cottonseed meal. 5 lbs. of salt added to each 100 lbs. of supplement.

Table 7. Milo vs. corn for fattening pigs, average of two replicates, Feb. 1, 1952 to May 20, 1952.

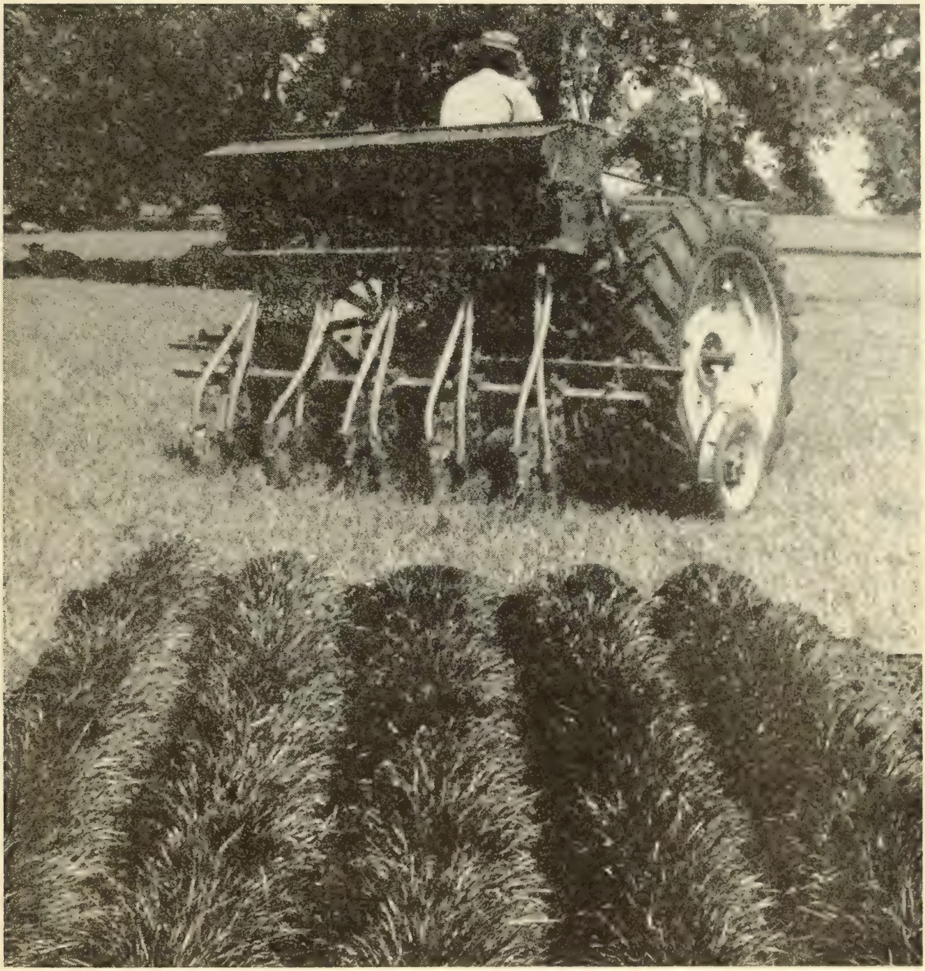
Lot	1	2	3	4	5
Ration	Ground Corn 90 Tankage 10	Ground Milo 90 Tankage 10	Shelled corn and tankage free choice	Ground Milo and tankage free choice	Ground Corn 81 Tankage 19
No. of pigs per lot	2	2	2	2	2
Av. initial wt.	69.5	75.7	68.7	72.7	72.5
Av. final wt.	206.7	193.0	204.5	206.2	198.7
Av. daily gain	1.37	1.19	1.46	1.35	1.43
FEED PER 100 LBS. GAIN					
corn	473.8	-------	354.7	-------	389.6
milo	-------	543.7	-------	412.4	-------
tankage	54.6	60.4	35.6	46.7	91.4
Total	528.4	603.1	390.3	459.1	481.0
Relative Efficiency %	100	87	135	115	109

All lots grazed rye grass forage.

BULLETIN 505 OCTOBER 1953

SEEDING IN PERMANENT PASTURE

For Supplementary Winter Grazing



MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

SEEDING IN PERMANENT PASTURE FOR SUPPLEMENTARY WINTER GRAZING

By RICHARD F. DUDLEY and LOUIS N. WISE[1]

Introduction

The conventional method of seeding supplementary winter grazing crops, such as oats, wheat and ryegrass, requires extensive land preparation resulting in high labor and equipment cost. On heavy wet soil types, complete seedbed preparation often results in excessive bogging of animals and trampling of the forage during the winter grazing period.

Under average Mississippi conditions three acres of pasture are required to adequately support one animal unit. A method of seeding a supplementary winter grazing crop in a summer permanent pasture sod, with no appreciable damage to the pasture, should provide two grazing seasons on the same area and significantly reduce the acreage requirement per animal unit.

Materials and Methods

The Agricultural Engineering and Agronomy Departments of the Mississippi Agricultural Experiment Station began a study in the fall of 1949 to determine the best cultural methods of seeding and fertilizing winter grazing crops in summer permanent pasture sods for supplementary winter grazing.

To seed and fertilize a supplementary crop in a permanent pasture sod with minimum damage to the pasture, it was necessary to develop special equipment. Several types of sod openers were tested, and it was found that a thin opener (1" thick) sharpened to a knife edge with a suction point attached on the bottom gave good results in all types of soil encountered. The cutting edge sliced through the sod and produced very little disturbance to the sod. These openers were mounted on a friction safety device which was attached to the tractor toolbar bedder. A safety trip was found to be very desirable when operating in pastures where stumps, roots and rocks might be encountered. Above the toolbar, a seed and fertilizer box was mounted rigid to the tractor axle housing. The seed and fertilizer were carried to the openers through flexible tubes. The toolbar and openers were raised hydraulically by the lift arms of the tractor and the driving mechanism automatically disengaged or engaged as the toolbar was raised or lowered. The drive was directly connected to the tractor axle. To allow separation of the seed and fertilizer a second opener was mounted behind and about an inch to the side of the first opener. The second opener, mounted an inch higher than the first opener, placed the seed an inch to the side and one inch above the fertilizer. The depth was controlled by the depth gauge wheels located on each end of the toolbar.

In the fall of 1949, test plots were established at the Brown Loam, Black Belt, Coastal Plain and Northeast Mississippi Experiment Stations (located at Oakley, Brooksville, Newton and Verona, respectively). At each location the following treatments were applied to a permanent pasture sod consisting of Dallisgrass, Bermuda-grass, and white clover:

1. Oats and fertilizer drilled in the sod at 8" intervals.
2. Oats and fertilizer drilled in the sod at 16" intervals.

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[1] Richard F. Dudley and Louis N. Wise, Assistant Agricultural Engineer and Associate Agronomist, Mississippi Agricultural Experiment Station, respectively.

Conducted in cooperation with Robert C. Albritton, Superintendent, Northeast Mississippi Branch Experiment Station; Robert E. Coates, Assistant Agronomist, Brown Loam Branch Experiment Station; Kelley C. Freeman, Assistant Agronomist, Coastal Plain Branch Experiment Station; Louie B. Walton, Superintendent, Black Belt Branch Experiment Station.

Robert E. Coates, Assistant Agronomist, Brown Loam Branch Experiment Station, will use the data reported in this paper for the preparation of a thesis to be submitted in partial fulfillment of the requirements of an M.S. degree.

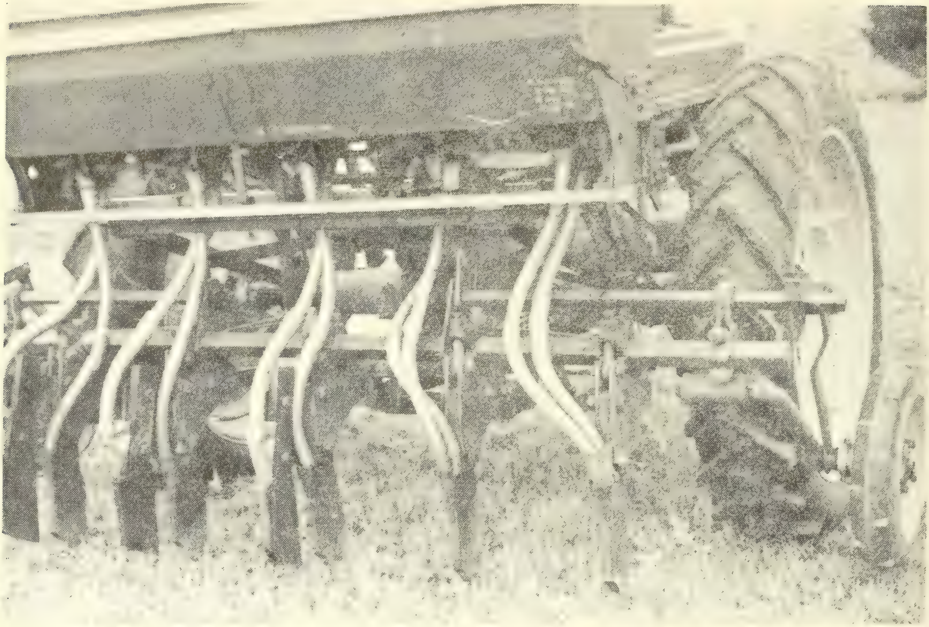

Figure 1. Experimental equipment developed to study the principles of seeding and fertilizing supplementary winter growing crops in a permanent pasture sod. Note arrangement for obtaining fertilizer placement variable.

3. Oats seeded and fertilizer applied to the sod with grain drill; disced.

4. Sod disced; oat seed and fertilizer applied with grain drill.

5. Conventional or complete seedbed preparation. Oats seeded and fertilizer applied with grain drill.

6. Ryegrass seeded and fertilizer applied with grain drill on undisturbed sod.

7. Oats seeded and fertilizer applied with grain drill to undisturbed sod.

8. Check—fertilizer applied to sod, no seedbed preparation and no seeding.

Oats and fertilizer were drilled into the sod in one operation at both 8" and 16" spacings. In the conventional plots, a good seedbed was prepared by discing four or five times, and the oats and fertilizer were sown with a regular grain drill. Oats were seeded at the rate of

Table 1. Influence of methods of seeding oats in permanent pasture sod as measured by yield per acre of dry forage. Seed and fertilizer separated. (1949-50; four locations).

Treatments—Methods of seeding	Brown Loam	Black Belt	Coastal Plains	North-east Miss.	Average 4 locations
Drilled at 8" intervals	3204	4745	2059	2123	3032
Drilled at 16" intervals	3018	4224	1634	1943	2779
Disced and seeded	2274	3009	1571	2115	2242
Seeded and disced	2542	3268	1480	1519	2202
Conventional seedbed preparation	2752	3280	1796	2093	2480
Ryegrass seeded on top	1911	2641	1667	1246	1866
Oats seeded on top of sod	1693	3089	1578	1432	1948
Check	1862	1037	1183	1059	1285
LSD (.05)	442	669	497	552	
LSD (.01)	592	898	667	740	

four bushels per acre and fertilizer applied at the rate of 60 pounds of nitrogen from sulfate of ammonia, 60 pounds of P_2O_5 from superphosphate, and 50 pounds of K_2O from muriate of potash per acre on all plots including the check plot. All tests were arranged in a randomized complete block design with six replications.

Results and Discussion

1949-1950

Three clippings were made at each of the four locations during the 1949-50 season. Results are summarized in Table 1.

At all locations, the highest yielding treatment was oats drilled into the sod at 8" intervals. The 16" spacing gave only slightly lower yields and both were generally superior to plots seeded in the conventional manner.

Early growth of supplemental pasture is very important in a winter grazing program. The practice of drilling seed and fertilizer into the sod resulted in considerably more fall and winter production than did the conventional method. (Table 2.)

A single clipping was made during the following summer (July, 1950) to determine the effect of the oats and method of seeding on the subsequent production of the permanent pasture sod to which the treatment has been applied. (Table 3.)

Highest summer yields were generally obtained from the undisturbed, unseeded check plots. Production was generally higher on the plots on which oats had been seeded the previous fall in 16" spacings than in the narrower 8" drills. Summer yields were higher on both the 8" and 16" plots than where oats had been seeded on a conventional seedbed. In general, summer production of the permanent pasture was reduced in proportion to the degree to which the sod had been disturbed the previous fall.

1950-1951

The investigation was continued in the fall of 1950. Incorporated in the 1950-51 test was an additional factor involving fertlizer placement. On half of each of the 8" and 16" spaced plots, seed (oats) and fertilizer were separated in the drill (as in 1949-50), the fertilizer being placed approximately one inch below and slightly to the side of the seed. On the

Table 2. Seasonal distribution of oat forage production as influenced by method of seeding. Avevarge of four locations (1949-50).

Treatments—Method of seeding	Yield in lbs. per A of dry forage 1st clipping (January)	2nd clipping (March)	3rd clipping (May)	Total
8" spacing	532	645	1855	3062
16" spacing	438	601	1741	2780
Conventional	149	411	1920	2480
Ryegrass on top	0	44	1822	1866
Check	0	0	1285	1285

Table 3. Influence of method of seeding oats in a permanent pasture on the yield of the permanent pasture duriing the subsequent season. Four locations; summer 1950.

Treatments—Methods of seeding	Yield of permanent pasture in lbs. per A of dry forage Brown Loam	Coastal Plain	Black Belt	Northeast Miss.	Average
8" spacing	2621	1405	1090	1584	1675
16" spacing	2961	1303	1526	1591	1846
Conventional seedbed	2379	971	895	802	1278
Check (undisturbed)	2867	1221	1428	2669	2046
LSD (.05)	466	241	225	598	
LSD (.01)	626	324	302	803	

other half of these plots, seed and fertilizer were applied together in the drill (mixed). The rate and type of fertilizer materials used was the same as described for the 1949-50 test.

Oats seeded in the sod at 8" and 16" intervals consistently produced more forage than those seeded on a prepared seedbed. At two of the three locations reported, production was higher on the 16" treatments than on those seeded at the closer spacing. (Table 4.)

At all locations except the Black Belt, mixing of the seed and fertilizer in the drill resulted in lower and slower rates of germination, in poorer growth of the seedlings, and lower initial production of forage. As indicated in Table 5, damage to the seeds or seedlings due to direct contact with the fertlilizer in the drill was generally more pronounced on the 16" than on the 8" spacings. Since the per acre rate of application of seed and fertilizer is constant for all treatments, the concentration of fertilizer per unit area was higher in the 16" drills and more damage to the oats would be expected.

Because of erratic stands, no results are reported from the Black Belt Branch Experiment Station. Visual observation of the initial growth at this location and of several large field seedings not included in the tests being reported, indicated variable response to fertilizer placement. Mixing of seed and fertilizer in the drill did not always result in injury to stands or lowered production. Soil moisture appeared to determine the occurrence and extent of damage resulting from this practice. At one moisture level, germination and stand establishment was severely affected by placing the seed in contact with the fertilizer. At another moisture level, even at the same location, no damage occurred.

1951-1952

The study was revised in the fall of

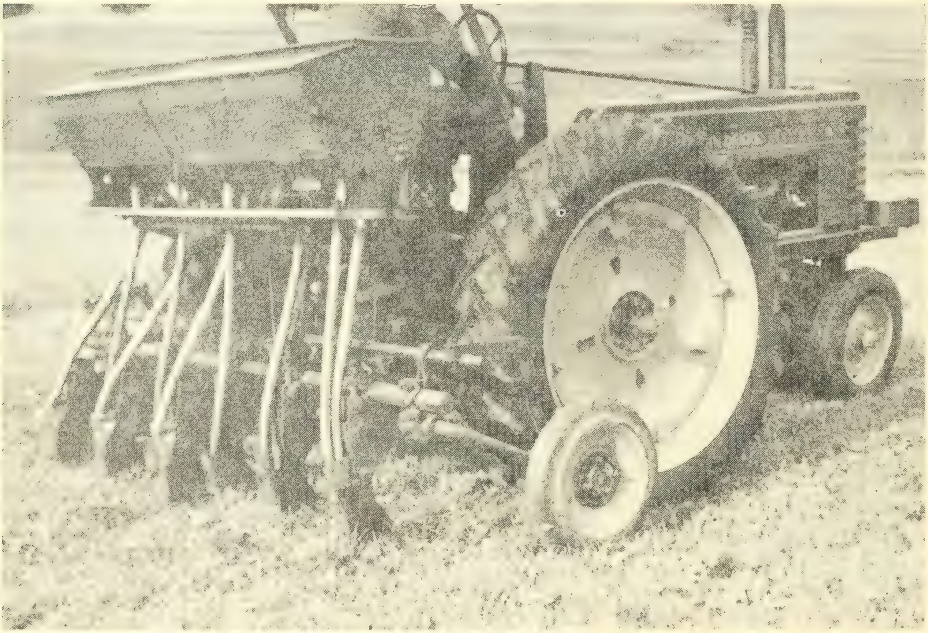

Figure 2. Shows experimental machine operating in a permanent pasture sod. The two openers on the right place the seed and fertilizer together, the three openers on the left separate the seed and fertilizer.

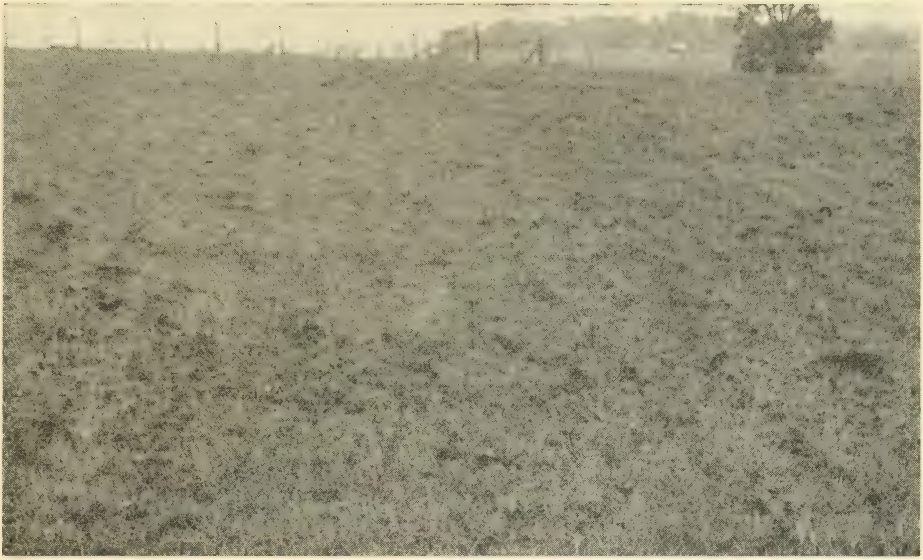

Figure 3. Illustrates the minimum damage suffered by the sod when ryegrass was seeded into a permanent pasture at 16" intervals. Picture taken immediately after seeding operation. (Brown Loam Branch Experiment Station.)

Table 4. Influence of method of seeding oats in permanent pasture sod on the yield per acre of dry oat forage. 1950-51; three locations.

Treatment—Method of seeding	Yield in lbs. per A of dry forage—all clippings* Brown Loam	 Coastal Plain	 Northeast Miss.	 Average of 3 locations
8" spacing	4132	2493	1746	2790
16" spacing	3735	3190	2007	2981
Conventional seedbed	3116	1165**	1288	1856
Check	2071	2036	628	1578

*Number and date of clippings at each location:
Brown Loam—3 clippings—November 10, March 23, and May 5.
Coastal Plain—3 clippings—November 15, April 2, and May 18.
Verona—1 clipping—April 24.
**Represents only 2 clippings; other treatments means at this location include 3 clippings.

Table 5. Effect of fertilizer placement on the yield of oats seeded in the sod at three locations. 1950-51.

Treatments Method of seeding	Seed & fertilizer separated	Seed & fertilizer together	Percent increase due to separation of seed and fertilizer
	Northeast Miss.—Only one clipping obtained		
8" spacing	1746	1095	59%
16" spacing	2007	1147	75%
	Brown Loam—1st and 2nd clipping		
8" spacing	1984	1312	51%
16" spacing	1756	1206	46%
	Coastal Plain—1st and 2nd clipping		
8" spacing	1301	1105	18%
16" spacing	1491	1147	30%

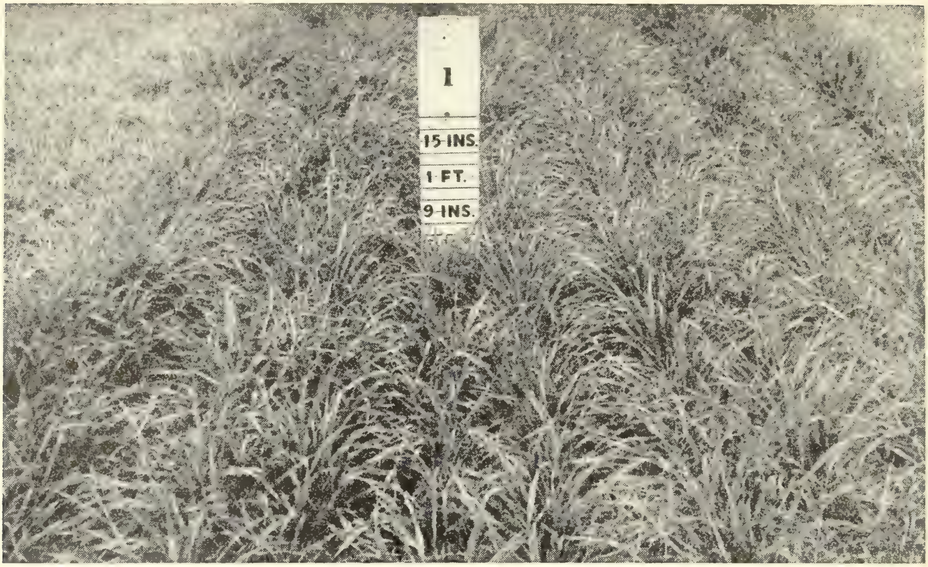

Figure 4. Oats seeded directly in sod with experimental seeder at 8" spacing. The seed and fertilizer was separated . Seeded Sept. 28, 1949 at Verona. Photo Dec. 19, 1949.

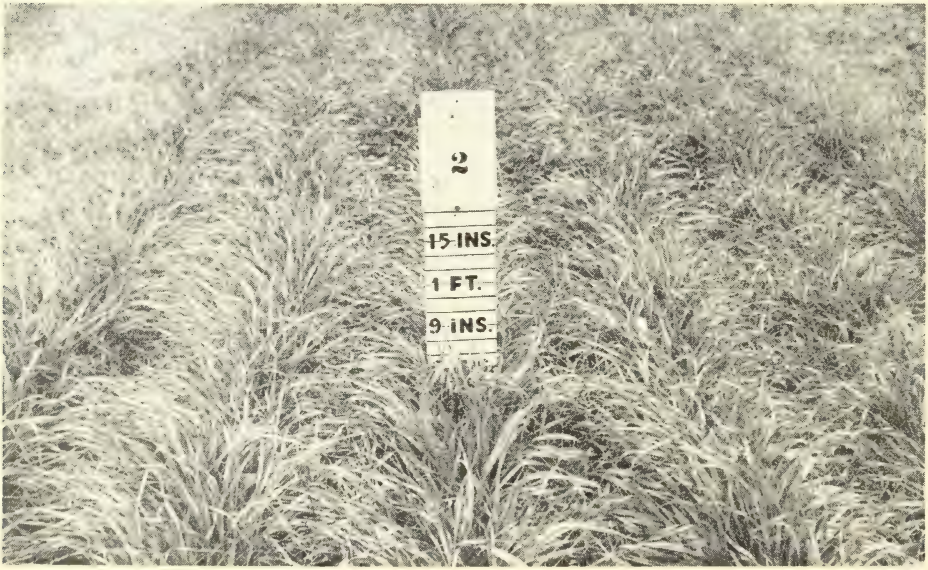

Figure 5. Oats seeded directly in the sod with experimental machine at 16" spacing. The seed and fertilizer was separated. Seeded Sept. 28, 1949 at Verona. Photo Dec. 19, 1949.

1951 to include, in addition to oats, ryegrass and fescue. The revised test consisted of the following treatments:

1. Oats and fertilizer drilled into the sod at 8" intervals.
2. Oats and fertilizer drilled into the sod at 16" intervals.
3. Conventional or complete seedbed preparation. Oats seeded and fertilizer applied with grain drill.
4. Ryegrass and fertilizer drilled into the sod at 8" intervals.
5. Ryegrass and fertilizer drilled into the sod at 16" intervals.
6. Ryegrass and fertilizer broadcast on the sod.
7. Conventional or complete seedbed preparation. Ryegrass seeded and fertilizer applied with grain drill.
8. Fescue and fertilizer drilled into the sod at 8" intervals.
9. Fescue and fertilizer drilled into the sod at 16" intervals.
10. Conventional or complete seedbed preparation. Fescue seeded and fertilizer applied with grain drill.
11. Check—fertilizer broadcast on sod, no seeding.

The seeding rates for oats, ryegrass and fescue were 120, 20 and 10 pounds per acre, respectively. The rate of fertilizer applied, the materials used, and method of placement was similar to the previous year's tests.

Two clippings were made at each of four locations; and the resulting total yields, disregarding the fertilizer placement variable, are presented in Table 6.

At the Brown Loam Branch Experiment Station, conventionally seeded plots generally outyielded those drilled into the sod at either 8" or 16" intervals. The 16" treatments consistently produced more oat and ryegrass forage than did the 8" treatments. Competition for moisture appeared to be the most important factor governing treatment response. The 1951-52 season was exceptionally dry; complete seedbed preparation more nearly eliminated the competition from the permanent pasture species for the limited moisture supply. Similar results were obtained at Verona.

At the Black Belt and Coastal Plain Stations the relative ranking of the 8" and 16" treatments and of the convention-

Table 6. Influence of methods of seeding oats, ryegrass and fescue in a permanent pasture sod on the yield of dry forage. Seed and fertilizer separated. (1951-52, four locations).

Treatments—Method of seeding	Yield in lbs. per A of dry forage—Average of all clippings*				
	Brown Loam	Black Belt	Coastal Plain	Northeast Miss.	Average of 4 locations
Oats					
8" spacing	4626	6031	6476	4298	5358
16" spacing	5464	5590	5853	4685	5398
Conventional	7936	4133	5456	5231	5689
Ryegrass					
8" spacing	4073	4191	7086	4921	5068
16" spacing	4490	5083	5815	7318	5676
Surface broadcast	2780	3678	1036	3574	2767
Conventional	5940	3606	4085	6203	4958
Fescue					
8" spacing	3024	1737	3088	3510	2841
16" spacing	3934	1878	3120	3837	3192
Conventional	2715	627	616	3713	1918
Check	2340	1653	2575	716	1821

*Number and dates of clippings:
Brown Loam: April 11 and May 21, 1952.
Black Belt: April 3 and May 22, 1952.
Coastal Plain: November 13, 1951 and May 5, 1952.
Verona: October 10, 1951 and April 30, 1952.

ally seeded plots were reversed. Inconsistency in treatment response between locations may be the result of: (1) different moisture conditions at the time of seeding or during early growth of the seedlings, (2) differences in density and relative dormancy of the pasture sod on which the tests were located, or (3) other undetermined factors.

Broadcast seeding of ryegrass on an undisturbed sod resulted in practically no fall and winter production and in low total yields.

At the Black Belt Station, placement of fertilizer in contact with the seed generally resulted in poorer stands and reduced yields of oats, ryegrass and fescue. Since the per acre rate of application of seed and fertilizer was constant for all treatments, the concentration of fertilizer in contact with the seed was greater in the 16" drill intervals than at the closer 8" spacings. As indicated in Table 7, when seed and fertilizer were not separated injury to germination and to subsequent production was more pronounced at the wider spacing intervals.

Visual observation at the other three locations during the early part of the growing season, indicated no striking differences in stand or vigor of seedlings due to fertilizer placement.

1952-1953

The 8" treatments were eliminated in the 1952-53 studies; wheat was substituted for oats to reduce the danger of winter killing.

Satisfactory stands of supplementary forages were not obtained at several locations due to lack of moisture in the fall of 1952. Results are reported only for the test at the Brown Loam Branch Experiment Station. (Table 8.)

Slightly more wheat and ryegrass forage was produced at the 1st and 2nd clippings on the conventionally prepared and seeded plots than when these crops were drilled into the pasture sod. Competition for moisture was apparently the governing factor. Because of increased production at the 3rd and 4th clippings

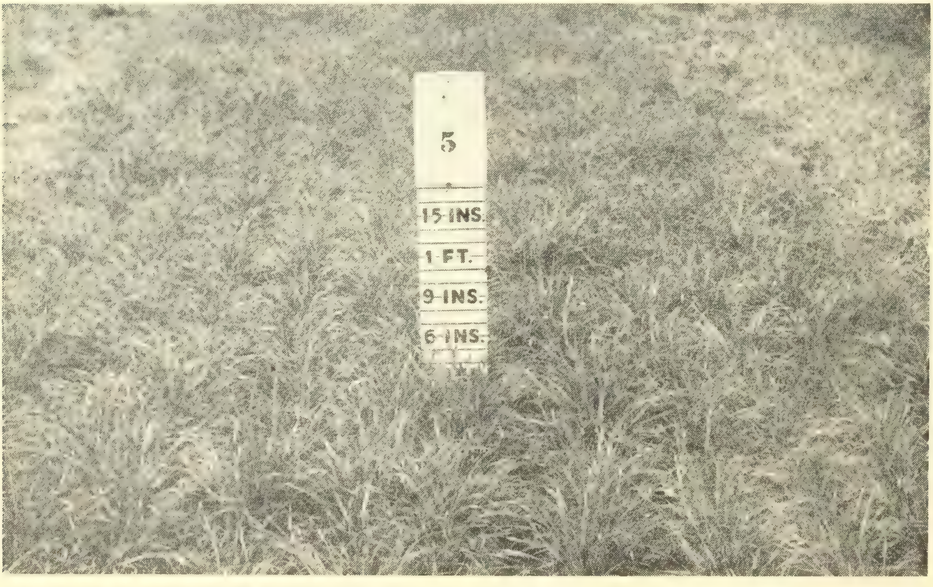

Figure 6. Oats seeded on a prepared seedbed (disced four or five times) with the conventional grain drill. Seeded Sept. 28, 1949 at Verona. Photo Dec. 19, 1949.

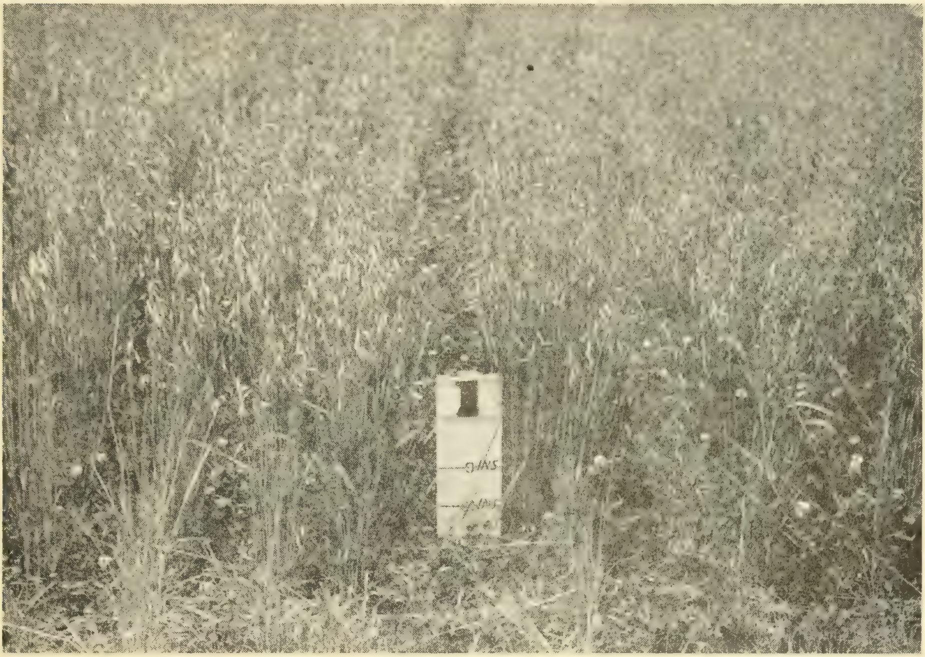

Figure 7. Oats seeded and fertilized directly in the sod at 8" spacing with experimental machine. Seeded Sept. 15, 1949 at Brooksville. Photo May 10, 1950.

on the seeded-in-the-sod plots, there was very little difference in total forage production as a result of treatments (methods of seeding). Although the check or unseeded plots produced a considerable quantity of forage, most of this production occurred in the late spring. Production of fescue followed a similar distribution curve, regardless of method of seeding.

There were no measurable differences in yield due to fertilizer placement.

Conclusions and Recommendations

Two years results indicate oats, wheat, ryegrass and other supplementary winter growing forage crops may be successfully seeded (drilled) in a permanent pasture sod without conventional seedbed preparation. Total yields of the supplemental forages seeded in this manner have been equal or superior to those obtained by the conventional method of complete seedbed preparation, and definitely superior to the yields of these crops when

Table 7. Effect of fertilizer placement on the yield of the first clipping of oats, ryegrass and fescue forage at the Black Belt Branch Experiment Station. (April, 1952).

Treatment— Method of seeding	Seed & fertilizer separated	Seed & fertilizer together	Percent increase due to separation of seed and fertilizer
Oats			
8" spacing	3212	3504	—9.0
16" spacing	2643	2306	+13.0
Ryegrass			
8" spacing	3372	2777	+21.0
16" spacing	2454	1873	+31.0
Fescue			
8" spacing	765	626	+22.0
16" spacing	1320	873	+51.0

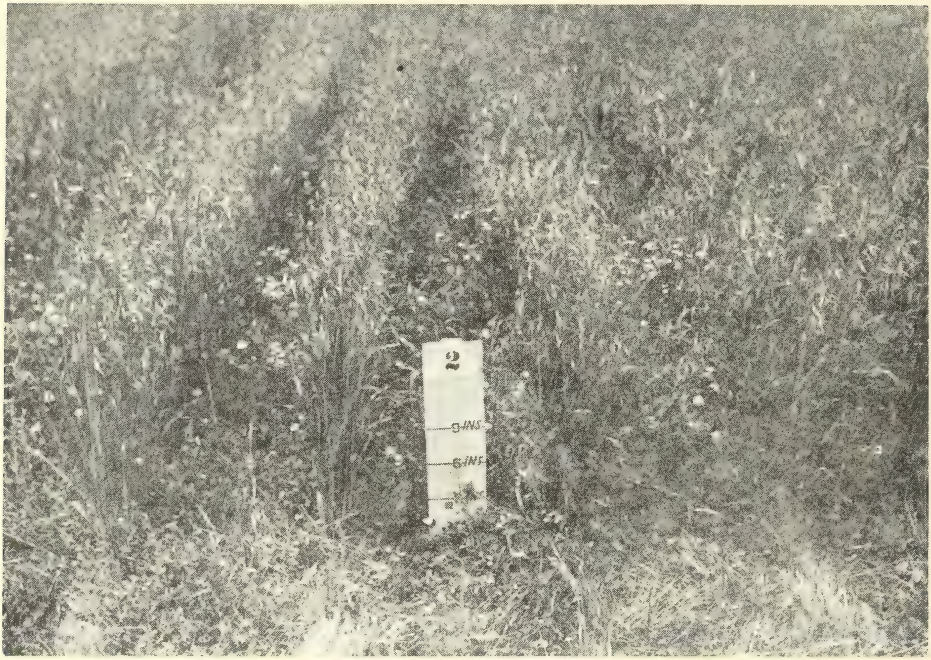

Figure 8. Oats seeded directly in the sod at 16" spacing with experimental machine. Seeded Sept. 15, 1949 at Brooksville. Photo May 10, 1950.

Table 8. Influence of method of seeding and fertilizer placement on the yield of wheat, ryegrass and fescue forage at the Brown Loam Branch Experiment Station (1952-53.)

Treatments— Method of seeding	1st clipping Jan. 29	2nd clipping Feb. 16	3rd clipping April 8	4th clipping May 25	Total
Wheat					
16" spacing, seed & fert. separated	417	690	2838	2346	6291
16" spacing, seed & fert. together	402	623	2529	2580	6134
Conventional seedbed	771	1035	1893	959	4658
Ryegrass					
16" spacing, seed & fert. separated	227	582	2298	3074	6181
16" spacing, seed & fert. together	313	565	2148	2709	5735
Broadcast on sod, no preparation	112	597	2430	3035	6174
Conventional seedbed	357	954	2465	2769	6544
Fescue					
16" spacing, seed & fert. separated	0	0	1844	3209	5053
16" spacing, seed & fert. together	0	0	1810	3485	5295
Conventional seedbed	0	0	1127	3596	4723
Check	0	0	1720	3281	5001

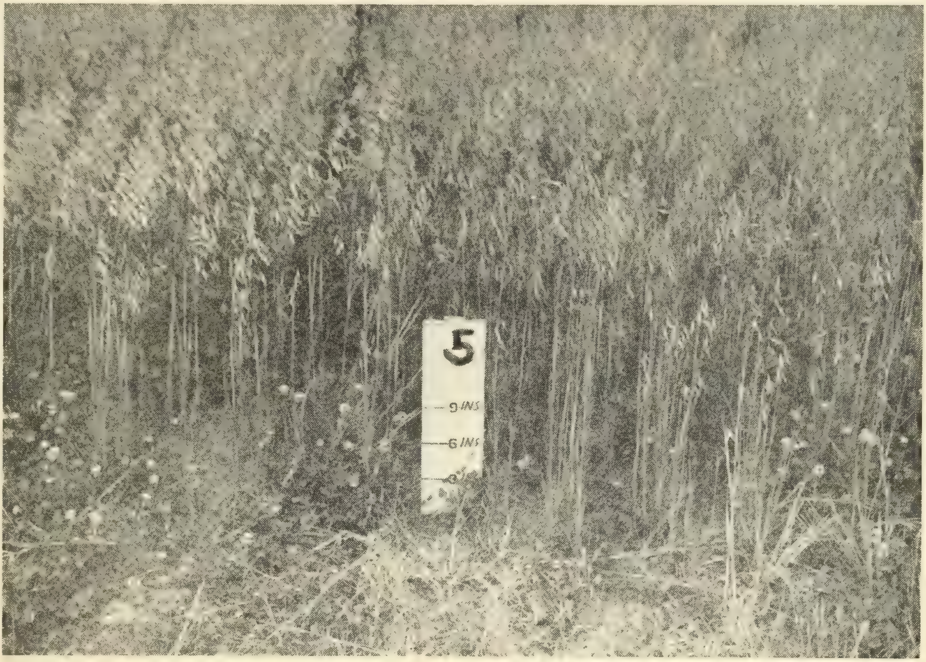

Figure 9. Conventional practice—oats and fertilizer seeded on a prepared seedbed with grain drill. Seeded Sept. 15, 1949 at Brooksville. Photo May 10, 1950.

seeded on the surface with no preparation or with varying degrees and methods of seedbed preparation (discing, etc.).

Damage to the permanent pasture was proportional to the degree the sod had been disturbed during the seeding operation and to the competitiveness of the resulting supplementary forage. The 8" seeding interval generally produced slightly more supplementary forage than the 16" spacing but the latter resulted in less damage to the permanent pasture. An even wider spacing might be used with equal effectiveness.

Competition between the supplementary crop and the permanent pasture may be reduced to a minimum by heavy grazing of the supplementary crop in late spring at the time the permanent pasture species resumes growth.

The supplemental crop (oats, wheat, rye, ryegrass, fescue, etc.) should not be drilled into the sod until the permanent pasture plants have become dormant or practically dormant. Earlier seeding results in competition between the seedling and the established sod for moisture, fertilizer and light. All excess forage must be removed by close grazing or clipping prior to seeding (drilling) the supplementary crop into the sod.

Moisture is the most critical factor influencing the success of sod seedlings. Low moisture levels in the fall reduce the earliness and total yields of the drilled seeding as compared to those seeded on a well prepared and fallowed seedbed.

Small grains should be drilled approximately 2" below the sod; ryegrass, fescue and other small grass or legume seeds should be placed about ½" deep. Although conventional seeding rates were used for all treatments during the course of this experiment, it appears logical that this rate could be reduced one-third to one-half when 16" or wider spacings are used, without reducing the yields.

The amount of fertilizer to be applied

is the same as recommended for the crop when seeded in the conventional manner. Due to the higher rates of fertilization now being recommended, and the proportionately higher concentration of fertilizer in the drill resulting from wider spacing of the drills, seed and fertilizer should be separated. The fertilizer should be placed directly below the seed or as nearly directly below the seed as possible with available equipment. Mixing of the seed and fertilizer (containing salts) in the drill will often result in lower and slower germination and in poorer initial growth of the seedlings.

Seeding of winter grazing annual crops in a permanent pasture sod results in: (1) lower pasture establishment cost, (2) less bogging of animals and trampling of the forage during wet periods, (3) more efficient utilization of land resources, and (4) reduction of soil and water loss.

Machinery and Utilization

The equipment used in the course of this investigation was designed for experimental purposes and has given very satisfactory results in this basic study of seed and fertilizer placement in a pasture sod. It is recognized, however, that there are many modifications which should be made before a machine of this type is placed in production.

The machine should be a quick detachable or trail type. The fertilizer and seed hopper should be located as close as possible to the ground to aid in loading the seed and fertilizer. The fertilizer hopper should have a capacity of approximately 500 pounds and the seed box should carry about 100-120 pounds of small grains which would plant approximately one acre. Cut-a-way rolling coulters would aid in preventing the accumulation of trash in front of the openers if sufficient weight can be obtained to get the desired penetration. Independent action of each opener would give uniform planting depth especially in hilly pasture. The openers should have replaceable points and if possible the seed and fertilizer should be separated within the opener, thereby eliminating the need for a second opener.

Several types of sod-seeding equipment, possessing in various degrees the above described specifications, are now commercially available. Additional models by other farm machinery manufacturers are anticipated.

Such machines should have wide ap- Their value in the seeding of small grains plication in grassland farming practices. and other annual grasses in permanent pasture sods has been adequately demonstated. It is anticipated that the following operations could be accomplished with equal effectiveness.

1. Seeding of legumes such as wild winter peas, red clover, or lespedeza in Johnsongrass, small grains or in any type pasture to which the addition of legumes is desired.

2. Reseeding and fertilization (renovation) of permanent pastures without seedbed preparation and the resulting loss in grazing.

3. Seeding and fertilization of perennial grasses and legumes on very steep, highly erosible areas.

4. Seeding and fertilization of small grains, ryegrass, or perennial grasses in a reseeding legume such as crimson clover, white clover, or lespedeza.

5. Seeding and fertilization of a summer supplementary forage such as millet or Sudangrass on an area seeded the previous season with winter annuals such as crimson clover, small grains, etc. Millet and Sudangrass should not be seeded in a summer pasture sod. The fertilizer applied with the millet or Sudangrass stimulates the perennial species to the exclusion of the crop being seeded.

6. Seeding and fertilization of any pasture species on **prepared seedbeds.** The usefulness of this equipment is not confined to seeding in the sod.

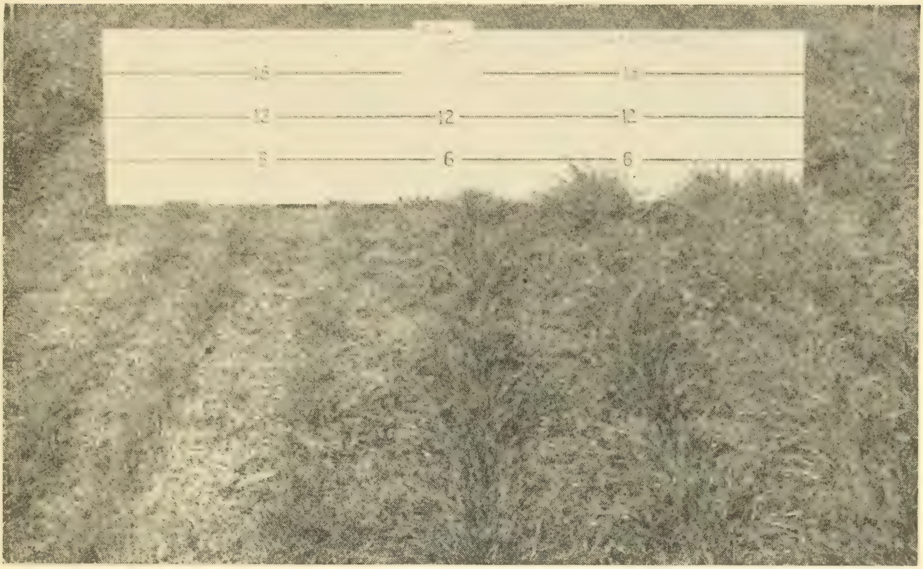

Figure 10. A comparison between ryegrass seeded in the sod with the fertilizer separated from the seed (right side of picture) and ryegrass seeded in the sod with the seed and fertilizer together (left side of picture). Seeded on September 28, 1951. This picture was made at Oakley, Miississippi, March 5, 1952.

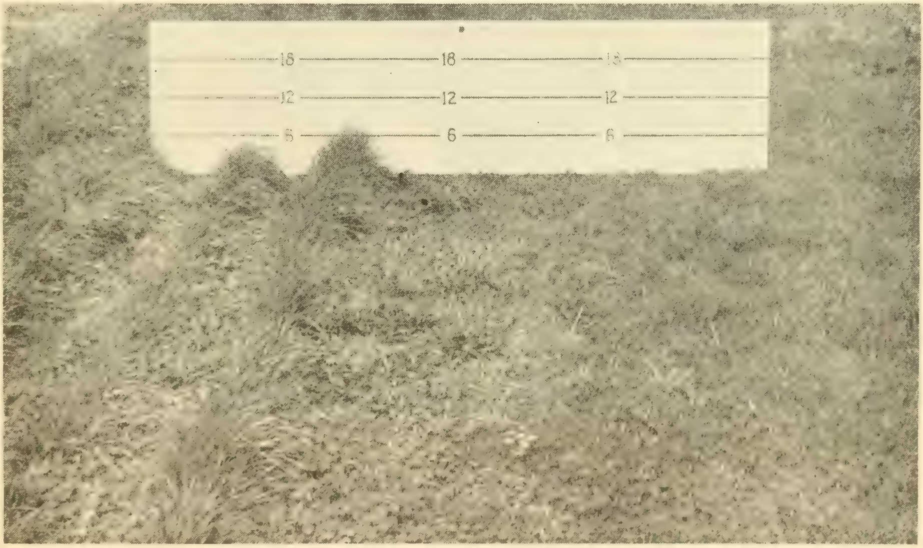

Figure 11. A comparison of ryegrass broadcast on top of the sod and fertilized (right side of picture) to ryegrass seeded and fertilized in the sod at 16" spacing (left of picture). Seeded on November 13, 1951. This picture was made at Newton, Mississippi, on March 4, 1952.

BULLETIN 506 NOVEMBER 1953

Methods of Wintering Bred Beef Cows

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

ON THE COVER:

This photo shows a group of Experiment Station cows grazing oat forage as a part of the study on wintering bred beef cows.

Methods Of Wintering Bred Beef Cows

By TROY B. PATTERSON[1]

Supplying satisfactory rations most economically during the winter months has long been the number one problem of commercial beef producers. Too often success of winter rations has been measured by cow survival alone. Recent experiments indicate that other factors are affected by the winter ration. Some of these are: birth weight, weaning weight, and over a number of years the percent calf crop may be affected.

Experiments reported by Leveck (1939) and Cullison (1940) testing several rations using home grown feeds for wintering beef cows included the following daily rations: 20 pounds grass hay, 1 pound cottonseed meal; 20 pounds lespedeza, soybean, or other legume hay; 15 pounds cottonseed hulls, 5 pounds grass hay, and 2 pounds of cottonseed meal; 30 pounds sorghum silage, 5 pounds grass hay, and 1 pound cottonseed meal. All of the above rations proved quite satisfactory for wintering bred beef cows weighing approximately 1,000 pounds.

Since most of the above rations require considerable labor in the harvesting, storing, and feeding, many stockmen are looking for a method of wintering their beef cows that requires a minimum of labor. With this in mind, the Mississippi Experiment Station started a test during the fall of 1946 to study the methods of feeding that require a minimum of labor and yet possibly improve on the existing rations.

Five Rations

One hundred twenty-five mature bred beef cows of Angus and Hereford breeding were divided into five uniform groups of 25 each and wintered as follows: Group I was fed a daily ration of 30 pounds sorghum silage, 5 pounds grass hay, and 1 pound cottonseed meal; Group II was wintered in permanent pasture where the cows had access to grass hay clipped and stacked in the pasture, and they were fed one pound cottonseed meal daily; Group III had stacked grass clippings alone in permanent pasture; Group IV cows were grazed continually on oat forage; Group V was wintered on oat forage for three hours daily. Because of the uncertainty of the oat crop, Groups IV and V were changed to fescue and ryegrass at the conclusion of 3 years study.

The winter period covered in this study was from about December 1 to March 15 or until pasture was available in the spring. All cows on test were handled in the same manner during the remaining portion of the year. They were divided into bull units according to breeds, without reference to winter treatment, and were placed on good permanent type pasture, consisting of clover and grass until about June 1 and Bermuda and Dallisgrass the remainder of the summer. The breeding season was from May 1 to August 1 so that calves would be dropped in February, March, and April.

As soon after birth as was practical each calf was weighed, numbered, and its sex recorded. In addition, the date of birth and the dam's number were recorded. All calves are weaned about the middle of November and weaning weights recorded at this time.

The cows in Group I were wintered in dry lot at the beef barn where tap water was available. Calving began on dry lot and continued on pasture after it became available in the spring.

The other groups were wintered in their respective pastures where water was

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[1] This report covers research work done by Henry H. Leveck, Ben F. Barrentine and Lindsey Horn in addition to the author.

Stacked pasture clippings alone and with cottonseed meal were two of the beef cow winter rations tested.

available in stock ponds. No shelter other than natural cover was provided for the cows wintered on pasture. No minerals other than block salt were available to all cows throughout the year.

Results of the first 6 years of this experiment are summarized in Table 1. Some of the differences in calving percentages may be explained by weather conditions of the preceding winter. The percent calf crop is affected by the previous winter feeding period rather than the one just prior to calving. This may be explained by the fact that the winter ration affects subsequent conception rate, so that cows wintered well will settle better in the spring, resulting in a higher percent calf crop the following year.

An example of this may be seen by referring to Table 1, ration 3, 1951 percent calf crop. At least a portion of the higher percent calf crop for that year was due to the milder winter of 1950 and as a result more green forage was available to these cows. Other percentages for 1951 were not affected to such a great extent because the rations of the other groups were sufficient to give normal percent calf crop.

Loss or Gain of Weight in Cows

A six-year average of the gain or loss during the winter months shows considerable variation between various rations, with a high of 67 pounds gained for cows on continuous grazing and a net loss of 9 pounds for cows wintered on pasture clippings alone. Oats were used as the grazing crop during the first 3 years of the experiment but due to the risk of winter kill, continuous grazing was changed to fescue and part-time grazing was changed to ryegrass.

Fescue was seeded on permanent pasture sod and nitrated with 150 pounds of ammonium nitrate per acre in the fall. For the three years included in this study fescue (one acre per cow) has not produced sufficient forage any year to maintain the cows without the use of harvested feeds. Not all of the difference in gain or loss of weight then is due to grazing but a portion is due to other winter feeds. This was also true with part-time grazing where an early freeze in 1951 and late start due to drought caused a shortage of ryegrass forage during these years.

All rations produced a net gain for the six-year average, with the exception of pasture clippings alone. The cows fed silage, hay, and cottonseed meal showed a loss in 4 of the 6 years of the test, but had a slight average gain over the entire 6 years. Less variation was noted between years in this group because these cows are less affected by differences in the severity of the winter months.

All groups except those on silage, showed a relatively higher gain during the somewhat milder winter of 1949-50. During that winter cows given access to pastures picked up considerable green forage that was not available for those on dry lot. It was also noted that even though the gain or loss varied with the ration during the winter months, this difference tended to disappear before the end of the summer grazing season.

Weight Records of Calves

There is considerable variation in birth weight of the calves between the groups, with a range of 60.8 in Group III in 1947 to 72.3 in Group IV in 1951. An average for the six years shows a slight advantage in favor of the continuous grazing group with smaller calves from the cows wintered on pasture clippings alone. However, these differences are not great enough to be significant.

There was little difference between rate of gain for the different groups. A slightly higher daily rate of gain in favor of the continuous grazing group was noted and the cows on clippings alone produced calves that gained less than the calves from other groups. Perhaps a clearer picture of the effects of the winter rations may be had by looking at the weaning weights of the calves. Weaning weights for the calves in 1948 are not available. The lighter weaning weights for 1947 and 1949 are due to earlier weaning dates. Calves were weaned in September during these years and in November during 1950, 1951, and 1952.

With the exception of 1952, calves from cows that were wintered on pasture clippings weaned at a lighter weight than the calves from other groups. During the winter of 1951-52, the cows on 3-hour ryegrass grazing lost an average of 82 pounds per head due to insufficient forage as was pointed out earlier. During the same period, the cows on pasture clippings lost only 26 pounds per head. These losses were reflected in lower average daily gains and lighter weaning weights for the calves in these groups.

An average of the five years weaning weights available for this study shows a significantly lower weaning weight for calves on pasture clippings alone. This lower weight is due in part to lower average daily gains and in part to younger calves at weaning time. On an average they were approximately one week younger than the calves from other groups.

Percent Calf Crop

One of the most striking differences between the performance of the cows on pasture clippings alone and the cows on other rations is reflected in the percent calf crop. Averages based on the six complete years show no significant difference between the group, except Group III (on pasture clippings) which had about 10 percent lower calf crop than the average of the other lots.

Since the 1947 calf crop was materially affected by the previous winter treatment before the start of the test, it is then permissable to exclude this year from the calf crop averages. When this is done, the difference in percent calf crop becomes even greater with the following

Table 1. Results, expressed as averages, of test on method of wintering bred beef cows at State College, 1947-52.

Year	Gain or loss, cow wt., lbs[1]	Birth wt. calves, lbs.	Daily gain calves, lbs.	Weaning wt. calves, lbs.	Percent calf crop	Birth date calves	Age at weaning, days
Group I—30 lbs. sorghum silage, 5 lbs. hay, 1 lb. cottonseed meal							
1947	—6	61	1.70	377	68	3/1	185
1948	—3	64			100	3/11	
1949	49	65	1.68	358	83	3/2	174
1950	—15	68	1.51	452	90	2/25	255
1951	—9	69	1.43	428	84	3/9	249
1952	—5	69	1.51	425	94	3/23	235
Average	2	66	1.57	407	86	3/7	219
Group II—Pasture clippings, 1 lb. cottonseed meal							
1947	—25	63	1.78	380	72	3/4	182
1948	—22	66			86	3/13	
1949	51	72	1.72	356	80	3/11	164
1950	23	66	1.51	437	85	3/3	247
1951	19	66	1.47	437	86	3/5	253
1952	—1	67	1.51	440	86	3/10	248
Average	9	66	1.58	409	83	3/9	217
Group III—Pasture clippings alone							
1947	37	60	1.67	367	76	3/1	185
1948	—30	61			68	3/18	
1949	4	61	1.72	342	79	3/13	162
1950	2	72	1.45	422	63	3/12	241
1951	29	69	1.42	413	86	3/15	243
1952	—26	68	1.45	410	70	3/22	238
Average	—9	65	1.54	390	74	3/14	212
Group IV—Continuous oat grazing[3]							
1947	124	66	1.78	400	68	2/26	188
1948[2]	36	68			78	3/5	
1949	70	66	1.85	380	92	3/6	169
Continuous fescue grazing[3]							
1950	57	72	1.62	485	94	2/27	253
1951	94	72	1.54	450	88	3/7	255
1952	21	71	1.47	411	90	3/27	230
Average	67	69	1.66	426	85	3/7	219
Group V —Limited oat grazing[3]							
1947	48	68	1.76	392	72	3/1	185
1948	—3	63			91	3/3	
1949	23	66	1.91	381	84	3/11	164
Limited rye grazing[3]							
1950	—22	68	1.50	441	93	3/7	249
1951	—106	66	1.50	446	90	3/7	252
1952	—82	70	1.39	400	73	3/22	236
Average	—19	67	1.60	412	84	3/9	217

[1] Average weight of cows at the beginning of the study December 2, 1946: Group I, 937; Group II, 964; Group III, 948; Group IV, 941; Group V, 953.

[2] There were 25 cows in each group every year except 1948 when there were only 10 cows on continuous grazing.

[3] All winter grazing rations required supplementary stored feed when dry weather or low temperature reduced forage yields. See discussion in text.

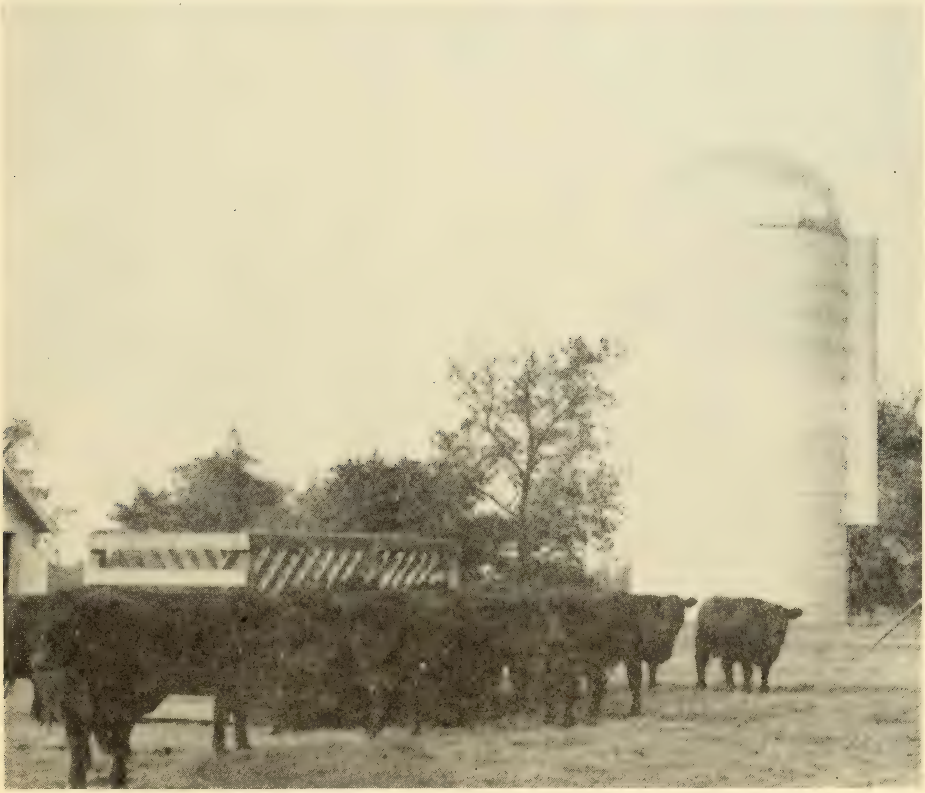
percentages noted: Group I, 90%; Group II, 85%; Group III, 73%; Group IV, 89%; and Group V, 87%. This probably reflects more accurately the actual effects of winter ration on percent calf crop.

Without exception, milder winters that caused some green forage to be available on permanent pastures were reflected in a higher conception rate the following spring, particularly for the cows on the poorer rations. A good example of this may be seen by referring to Table I, Group III, 1951, where a 86.6 percent calf crop was recorded for these cows following the comparatively mild winter of 1949-50. The 100 percent recorded in Group I for 1948 makes the average for this group appear somewhat better than is the actual case. However, over a longer period of time this effect would tend to be reduced to a minimum.

Cost of the Various Rations

Due to the differences in labor, types of crops grown, and machinery available in the different sections of the state no attempt will be made to give specific cost of each ration. However, approximate cost figures will be given so that comparisons can be made.

Costs of producing silage vary with several factors such as yield, lodging, method of harvesting, storage, and others. Cost of producing silage at the Station has varied considerably from year to year, but on the average it has cost about $6.00 per ton to produce and harvest. On this basis, ration 1 will cost about $17 to



One group received silage, hay and meal in dry lot.

feed a cow for 90 days. This figure also includes the cost of hay and cottonseed meal at current market prices.

Cost of ration II is estimated at about $23.60 per cow for 90 days and ration III $20 per cow, the only difference being the cost of 90 pounds of cottonseed meal at $80 per ton. The clippings are a by-product of the pasture with labor, particularly that involved in stacking, representing the cost.

Since larger acreages are necessary for continuous grazing, the cost of this method of wintering cows is considerably higher than the other rations. Oats planted for grazing cost about $22.50 per acre and at least 2 acres per cow are needed for continuous grazing throughout the winter months. This gives about $45 per cow for Group IV. If for any reason the oats fail to produce sufficient forage and stored feeds have to be used, the cost of this ration would then be increased. Fescue used during the latter three years cost considerably less than oats due to its reseeding ability. However, when the cost of supplemental feeds are taken into consideration, a per-cow cost of $40 is reached.

The limited grazing of Group V offers a more economical picture. Only one acre of oats per cow was needed at a cost of $22.50. It is also true in Group V, as in Group IV, that if winter kill occurs additional stored feeds are needed. This was also true when ryegrass was used instead of oats. Ryegrass did offer more resistance to winter kill and cost only $20 per acre to produce.

On the basis of the above prices, ration 1 appears to be the most economical if the equipment, labor and storage facilities are available for handling silage.

In areas where stacking pasture clippings or other hay crops for winter consumption is practiced, the value of protein supplement should be noted in this experiment. The addition of one pound cottonseed meal daily per cow to a ration of pasture clippings gives a return of 19 pounds of beef plus a 12 percent higher calf crop. In a herd of 100 cows a $360 investment in cottonseed meal would, at this rate, return 6,315 pounds of extra beef or the equivalent of 15 extra calves. Comparing Groups IV and V, however, presents a different picture. The additional cost of $2,125 to winter 100 cows on continuous grazing would return only 2,070 pounds of beef or only about 5 extra calves which at the present price level will not pay for the additional pasture. Other similar comparisons may be made from the above data.

Summary

Five methods of wintering bred beef cows were compared by the Mississippi Agricultural Experiment Station. The study extended over six winters and involved 125 cows. Analysis of the results shows:

(1) Four of the rations (silage, hay and meal; pasture clippings and meal; and two winter grazing groups) produced almost equally good results when measured in percent calf crop and weight of calves at weaning.

(2) Grass clippings alone did not measure up to the other four rations. Cows in this group calved later and produced 10 percent less calves. Their calves gained more slowly and weighed less at weaning than those from other groups. One pound of cottonseed meal, however, added to pasture clippings made a satisfactory ration.

(3) Oats proved unsatisfactory for grazing and after three years they were replaced by fescue and ryegrass for the remainder of the test. The cost and uncertainty of the crops made production of winter grazing for beef cows a less attractive proposition than the feeding of silage.

(4) Under conditions of this test 30 pounds silage, 5 pounds hay and 1 pound cottonseed meal was the most economical of the rations which proved satisfactory.

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PASTURES FOR DAIRY CATTLE

A Summary of Three Years Grazing Trials

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
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STATE COLLEGE MISSISSIPPI

CONTENTS

Page

Introduction 3

Topography, Soil Type and Climate of the Blackbelt Region 3

The Pasture Plots 5

Experimental Animals and Their Management 5

Methods of Measuring Pasture Value 6

Establishment of the Pastures 7

Grazing Data on the Various Plots 9

Total Digestible Nutrients and Milk Production Obtained from Pasture 11

Monetary and Feed Replacement Value of Various Pastures 14

Summary 17

Literature Cited 18

PASTURES FOR DAIRY CATTLE

A SUMMARY OF THREE YEARS GRAZING TRIALS

By

D. B. Roark, J. W. Lusk, J. T. Miles*, W. C. Cowsert and R. E. Waters**

INTRODUCTION

Pasture is our most important agricultural crop and is destined to become even more important as we learn to grow and manage it. It is estimated that pastures contribute more than one-third of all feed consumed by livestock in the United States and that more than one-third of the feed furnished by pastures is utilized by dairy cattle. Although pastures are an important source of feed for dairy cattle, pasture crops are usually the most neglected of all crops grown on the farm. Dairymen complain that milk production is low and milk production costs are high without realizing that properly planned and managed pastures can materially reduce milk production costs.

Many experiments and demonstrations have shown that pasture is the cheapest feed that can be grown for the dairy cow. Good pastures have other advantages . . . more digestible protein per acre is provided; labor is saved; erosion loss is reduced to a minimum; manure is returned to the land. Even so, pastures are rarely productive for more than a few months at a time. Usually, there is too much grass for a short period in the spring and too little for a longer period later in the season to insure efficient, uniform milk production. The goal of every dairyman should be an adequate amount of excellent grazing every day of the year. Heretofore, there has been little published information on the development of a grazing system for the Blackbelt region that would supply adequate pasturage throughout most of the year.

The experiments reported in this bulletin were conducted by the Dairy Department of the Mississippi Agricultural Experiment Station to determine the extent to which various annual and perennial pasture crops could be used to provide grazing for dairy cattle, and to determine the relative economy of the various crops as sources of nutrients for milk production.

Topography, Soil Type and Climate of the Blackbelt Region

The Blackbelt region lies between the Northeast Highland area on the north and east and the Flatwoods area on the south and west. The Mississippi Agricultural Experiment Station dairy farm is located on the western border of the Blackbelt region in an area referred to locally as the Post Oak Prairie area. Typical soils of this area are Oktibbeha clay loam, Vaiden fine sandy loam, Leeper fine sandy loam, Saltillo clay loam and other similar types.

Topographically, it is a land of gently rolling to steep hills among which are broad valleys and small streams. It is not uncommon for a small stream to have a flood plain a mile or more wide.

The Blackbelt material was laid down as a marine deposit in still water. The soils developed from soft limestone (Selma chalk), which was high in fertility, and heavy clays and sandy clays over the limestone. These parent materials gave rise to soils that are heavy in texture and somewhat poorly drained. The heavy texture imparts low permeability to the soil which causes great runoff of rainfall. The high lime content flocculates the particles into aggregates which erode easily. Consequently, these properties of the soil under heavy rainfall have caused severe soil erosion.

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The climate of the Blackbelt region is well adapted for plant growth. The winters are relatively mild and short and the summers are long. As shown in Table 1, the temperature seldom falls below freezing in the winter and rarely exceeds 100° F. in the summer. Frost generally disappears by noon and the ground rarely freezes. The growing season averages 226 days with the first frost occurring about November 6, and the last killing frost in the spring about March 25. The monthly range of temperatures and frost dates for the three experimental years and for the preceding 20 years are presented in Table 1. The intervals between killing frosts were normal during the experimental years with the exception of the 1949-1950 year when the interval was 27 days longer than normal.

The annual rainfall for the 20-year period preceding the experiment averaged 49.00 inches. It was distributed rather evenly throughout the year, with September and October being the driest months. These two months had an average of less than 3 inches rainfall each, and are the months when most winter grazing crops and permanent pastures are established. During each of the three experimental years, the rainfall during September was slightly higher than the 20-year average. Even though the average rainfall for the experimental years in October was similar to the 20-year average, the 1951-52 year was considerably lower (.99 inches) than the 20-year average. The rainfall during November of the experimental years was approximately one-half the 20-year average. The average monthly rainfall for the 20 years prior to the experiment and for each year of the experiment are presented in Table 2. During the period of the

Table 1. Monthly range of temperatures, date of last killing frost in spring and first killing frost in fall for the experimental years, and the 20-year period 1929-49.*

	Average Monthly Range of Temperature, ° F.							
	Average 20 Years 1929-1949		1949-1950		1950-1951		1951-1952	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
September	64.6	88.0	62.1	83.0	64.0	81.1	65.0	88.0
October	52.4	78.6	59.1	76.9	55.7	78.9	54.1	79.6
November	43.5	65.6	40.4	67.9	37.0	62.1	37.0	61.8
December	37.7	57.9	37.4	60.6	31.3	51.0	40.2	62.5
January	36.1	56.5	48.4	68.1	35.6	58.2	44.2	63.3
February	38.1	60.5	41.3	65.0	36.6	60.1	43.3	62.8
March	44.5	67.3	41.6	65.2	46.6	67.3	43.0	65.8
April	52.9	76.8	47.2	72.2	50.0	73.6	49.3	73.4
May	60.5	81.9	66.7	84.2	58.4	84.4	59.8	84.1
June	67.9	91.1	68.1	87.6	69.0	88.3	70.8	95.9
July	74.3	92.5	68.5	87.8	71.0	92.5	70.6	96.9
August	69.8	92.2	66.6	88.0	71.1	95.6	68.6	93.4
	Date of Killing Frost							
First Frost in Fall	Nov. 6		Nov. 1		Nov. 5		Nov. 3	
Last Frost in Spring	Mar. 25		April 15		Mar. 20		Mar. 17	
Days Subject to Frost	139		166		135		135	
Frost Free Days	226		199		230		231	

*These data are from the Weather Bureau Station at State College, Mississippi.

Table 2. Average Monthly Rainfall in Inches for the 20-Year Period 1929-49 and for Each Year of the Experiment.*

Month	1949-1950	1950-1951	1951-1952	Average 3 Experimental Years	Average 20 Years 1929-49
September	2.89	6.86	3.40	4.38	2.78
October	3.92	2.01	.99	2.64	2.67
November	.63	3.01	2.71	2.12	4.26
December	4.02	2.60	8.19	4.94	4.82
January	11.51	9.33	3.50	7.45	4.83
February	7.79	4.41	3.09	5.10	5.05
March	6.69	13.52	5.45	8.55	5.66
April	1.95	4.08	2.27	2.77	3.59
May	4.50	4.47	3.20	4.06	3.52
June	2.41	5.93	.29	2.88	3.16
July	8.51	3.15	2.06	5.24	5.39
August	9.53	3.25	2.74	5.17	3.30
Total	64.40	62.62	37.89	55.30	49.00

*These dates are from the Weather Bureau Station at State College, Mississippi.

experiment, the average total annual rainfall ranged from 37.89 inches, 11.11 inches below the 20-year average, in 1951-52 to 64.40 inches, 15.40 inches above, in 1949-50. The average annual rainfall during the experimental years averaged 6.30 inches more than the 20-year average preceding the experiment.

The Pasture Plots

The 36 acres of land selected for this study had been cleared of timber at least 50 years prior to the start of the experiment. The history of land use during this 50-year period is not definitely known except for the more recent years. It is probable, however, that it was cultivated in crops during the first 30 years after clearing. During recent years, the area was in native pasture or hay meadow and the complete area received essentially the same cultural treatment.

A detailed soil survey was made of the experimental area for use in laying out the various pasture plots. Plots 1 through 6 were located on hill land with rolling topography. Plots 7 to 18, inclusive, contained approximately one-third hill land and two-thirds valley land. The plots were laid out, insofar as possible, so that soil variability between plots was reduced to a minimum. Eighteen two-acre plots were laid out, fenced and individual water cups installed. The water supply to each plot came from a common source. The shape of the various plots approached squareness in order to reduce fencing costs and to insure more uniformity of grazing. Access to covered mineral boxes and temporary shades were provided for each plot.

The following pasture treatments, which were replicated three times, were used: (1) Dallis grass and white dutch clover, (2) alfalfa, (3) oats followed by millet, (4) crimson clover and serecia lespedeza, (5) crimson clover and ryegrass followed by grain sorghum or tift sudan, and (6) red clover and Johnson grass.

Land preparation consisted of plowing, followed by thorough disking and harrowing in order to bring the soil into good tilth. In most instances, disking and harrowing were continued at frequent intervals prior to fertilization and seeding in an attempt to destroy the growth of obnoxious plant species and to establish a good firm seedbed. The fertilizer nutrients that were added to the soil were in the form of individual plant food elements and were based on soil analysis and agronomic recommendations. The initial fertilizer applications and the maintenance applications are given in the appropriate sections on seeding and establishment of the various plots.

Pasture plots were mowed, when advisable, to control weeds and to remove clumps of ungrazed herbage resulting from selective grazing. Harrowing was done on some of the plots to scatter cattle droppings. Harrowing was done at a time that did not interfere with grazing and measurements of pasture yields.

Experimental Animals and Their Management

Lactating Jersey, Guernsey and Ayrshire cows from the College herd were selected as experimental animals. At the beginning of each experimental year, a "tester" cow was permanently assigned to each plot. These cows were assigned to be as near uniform between treatments as possible with respect to breed, age, level of production, health and stage of lactation. The "tester" cow was always grazed on the assigned plot when grazing was available. When additional cows were needed to effectively utilize available forage, "tester" cows from other plots not being grazed or similar cows from the College herd were used. This is the so-called "put and take" method of grazing.

The permanently assigned "tester" cows were weighed each two weeks. Any additional cows used were weighed each two weeks while grazing the experimental plots. In addition, all cows were weighed each time they were added to or removed from a plot. All weighings were made after the morning feeding and milking and prior to turning cows onto pasture.

The cows were milked twice daily with mechanical milkers and were grazed continuously on the experimental pastures when sufficient forage was available. During periods when ample forage was not available for grazing, the experimental animals were handled under routine herd management.

A concentrate mixture was fed to all cows twice each day before milking in order to maintain body weight and to prevent an abnormal decline in milk production. The rate of concentrate feeding varied according to the quality of the pasture and was based on the latest edition of Morrison's (2) grain feeding tables for cows on pasture. Weekly adjustments of concentrate feeding were made in accordance with the previous week's milk and butterfat production. All concentrates fed and refused were weighed. The digestible nutrients consumed from concentrates were calculated using the average figures presented by Morrison (2). The concentrate mixtures fed were compounded by mixing varying amounts of wheat bran, corn and cob meal, hominy, oats, cottonseed meal and soybean meal to give a mixture of about 14 per cent crude protein and 70 per cent total digestible nutrients. All animals had free access to a mineral mix in the plots and, in addition, the same mineral mix constituted 2 percent of the concentrate ration. During the first year and a half, the mineral mix consisted of equal parts salt, steamed bone meal and oyster shell flour. During the remainder of the experimental period, the mineral mixture was composed of equal parts salt and steamed bone meal or dicalcium phosphate.

Methods of Measuring Pasture Value

The plan of the experiment, including the weighing of the cows, recording of milk weights, butterfat tests, and the calculation of the total digestible nutrients derived from pasture was patterned after those described in "Preliminary Report on Pasture Investigation Technique" (4) and "Pasture and Range Research Techniques" (3). An effort was made to keep growth on all plots grazed to the same extent by adjusting (increasing or decreasing) the number of cows in accordance with the amount of forage available for grazing.

The quantities of total digestible nutrients obtained from the plots by the grazing animals were determined by first calculating the nutrients required for their maintenance, for their change in body weight, and for their production of milk and butterfat, and then deducting from this amount the quantity of nutrients they received from the concentrates fed. The difference was considered the amount of nutrients they received from pasture. The requirements for maintenance and milk production were calculated by use of the Morrison standard (2). The pasture was credited with 3.53 pounds of digestible nutrients for each pound of gain in body weight of the cattle and debited 2.73 pounds for each pound loss in weight (3).

The milk production of individual cows was kept daily and the monthly Herd Improvement Registry butterfat test was applied to the daily milk weights. The milk and butterfat yields were converted to a 4 percent fat-corrected milk according to the Gaines formula (1).

Returns from the pasture plots are expressed also in terms of standard cow-days. The standard cow-day is measured in terms of total digestible nutrients. It has been defined as the quantity of total digestible nutrients (16 pounds) required daily by a 1000-pound cow producing 25.3 pounds of 4 percent milk. Therefore, to determine the total number of standard cow-days per acre, the pounds of total digestible nutrients produced per acre were divided by 16. The daily carrying capacity per acre was obtained by dividing the standard cow-days by the actual days grazed.

The feed cost of producing 100 pounds 4 percent fat-corrected milk was calculated on the basis of the total expense required to produce the pasture plus the concentrate cost. The concentrate cost was obtained by multiplying the pounds of concentrate fed by $.0375, the average cost per pound of concentrate fed during the three-year experimental period. The pasture costs included the amounts spent for labor, machinery use, seed and fertilizer, but did not include rental on the land.

The value of the milk produced was calculated both as Grade A and manufacturing milk. The average Grade A price received during the three-year period was used to calculate the value of milk sold as Grade A. The value of manufacturing milk was based on the average price of manufacturing milk in this area during the same period.

To indicate the value of the various pasture and forage crops for grazing, calculations were made of their feed replacement value. The nutrients credited to the pastures were converted to annual lespedeza hay equivalent, assuming the hay to have a total digestible nutrient content of 47.5 percent and a dry matter content of 89.2 percent. The lespedeza hay equivalent shows the amount of lespedeza hay of good quality that would be required to supply the same amount of total digestible nutrients as was obtained from an acre of grazing.

Establishment of the Pastures

The rate and time of seeding and fertilization for the various pasture crops are shown in Table 3. Plots 1, 9 and 14 were planted to Dallis grass and white dutch clover. Prior to seeding, 100 pounds P_2O_5 furnished by 500 pounds 20 percent superphosphate, 50 pounds K_2O supplied by 100 pounds 50 per cent muriate of potash, 3000 pounds lime and 30 pounds borax were applied per acre. Between November 17 and 29, 1949, 15 pounds Dallis grass and 5 pounds inoculated white dutch clover per acre were sown separately with a cyclone hand seeder. The seed were covered by cultipacking. Phosphate and potash were applied biennially. The three-year average cost per acre for labor, seed and fertilizer was $24.45.

Plots 2, 10 and 15 were seeded with a wheelbarrow seeder on November 17, 1949 with 20 pounds Oklahoma common alfalfa per acre. These plots were fertilized on a per acre basis as follows: 100 pounds P_2O_5, 100 pounds K_2O, 4000 pounds lime and 30 pounds borax. A good stand was obtained; however, an early freeze reduced the stand to the extent that reseeding was desirable. These plots were reseeded March 13, 1950 and no fertilizer was applied at this reseeding. Again, a good stand was secured but late spring freezes in April (Table 1) necessitated reseeding on a well prepared seedbed on October 30, 1950. This second fall seeding resulted in a good stand, but so much winter kill occurred that these plots were reseeded, again, on August 25, 1951. Applications of phosphate and potash were repeated at this seeding. The land was fallowed from early July until the time of seeding. A satisfactory stand was secured with this seeding. The two-year average cost of these alfalfa plots was $65.52 per acre. This cost includes four seedings before a satisfactory stand was secured.

Different annual crops were planted in succession on various plots in an effort to provide continuous grazing throughout the year. Plots 3, 12 and 13 were planted in oats for fall and winter grazing followed by millet for spring and summer grazing. Each year, the oats were seeded with a grain drill at the rate of 4 bushels per acre on a prepared seedbed. Initial fertilizer applications consisted of 50 pounds P_2O_5, 25 pounds K_2O, 3000 pounds lime and 60 pounds nitrogen per acre. An additional 60 pounds nitrogen was applied per acre to the winter grazing crop each year in January or early February.

After grazing of the oats was terminated in late May or early June of each year, these plots were prepared, fertilized with 60 pounds nitrogen per acre, and seeded to millet. In 1950, 10 pounds millet was planted with a grain drill. Each succeeding year, the rate of millet seeding was increased to 20 pounds per acre. Biennial applications of 100 pounds P_2O_5 and 25 pounds K_2O were made on these plots. The combined average cost of these crops was $56.38 per acre for the three-year experimental period.

Considerable difficulty was encountered in securing satisfactory stands of

Table 3: The seed mixtures used, the rate and time of seeding and rates of initial and maintenance fertilization.

Plot Number and Pasture Crops	Time of Seeding	Seeding Rate Per Acre (Lbs.)	Fertilization Rate Per Acre (Lbs.)	
			Initial	Maintenance
1-9-14 Dallis Grass and White Dutch Clover	November 1949	15 Dallis Grass 5 White Dutch Clover	100 P_2O_5 50 K_2O 3000 lime 30 borax	Biennially 100 P_2O_5 50 K_2O
2-10-15 Alfalfa	November 1949 Reseeded: March 1950 October 1950, August 1951	20 Inoculated Oklahoma Common Alfalfa	100 P_2O_5 100 K_2O 4000 lime 30 borax	Biennially 100 P_2O_5 100 K_2O
3-12-13 Oats	November 1949 Reseeded: Oct. 1950 Aug. and Sept. 1951	128 Delta Red, Nortex 107 or Arlington Oats	50 P_2O_5 25 K_2O 3000 lime 60 N	Annually 60 N in Jan. or Feb. Biennially 100 P_2O_5 25 K_2O
followed by Millet	May 1950 Reseeded: May 1951, May 1952	10 Pearl Millet 1950 20 Each succeeding year	60 N	None
4-11-18 Crimson Clover and Sericea Lespedeza	Clover—November 1949 Sericea—March 1950 Reseeded: Sericea—April 1951 Clover—October 1951	30 Inoculated Dixie Reseeding Crimson Clover 30 Sericea, 1950 40 Sericea, 1951	100 P_2O_5 50 K_2O 3000 lime 20 borax	Biennially 100 P_2O_5 50 K_2O
5-7-17 Crimson Clover and Ryegrass	Nov. and Dec. 1949 Reseeded: Ryegrass—October 1950 Ryegrass and Clover— September 1951	30 Inoculated Dixie Reseeding Crimson Clover 15 Domestic Ryegrass	100 P_2O_5 50 K_2O 3000 lime 20 borax	Beginning 1950 60 N at seeding and 60 N in Jan. or Feb. Biennially 100 P_2O_5 50 K_2O
followed by Grain Sorghum or Tift Sudan	June 1950 June 1951 Reseeded: May 1952	10 Grain Sorghum in 42-inch rows 20 Tift Sudan	60 N	None
6-8-16 Johnson Grass and Red Clover	Feb. and Mar. 1950 Reseeded: Clover—October 1950 Johnson Grass—April 1950 Clover—October 1951 Clover—March 1952	15 Johnson Grass 8 Inoculated Kenland Red Clover	100 P_2O_5 50 K_2O 3000 lime 20 borax	Biennially 100 P_2O_5 50 K_2O

the crimson clover sericea lespedeza combination on plots 4, 11 and 18. Between November 17 and 25, 1949, 30 pounds inoculated Dixie reseeding crimson clover was sown per acre with a wheelbarrow seeder on these plots. The seed were covered by cultipacking. Fertilizer applications consisted of 100 pounds P_2O_5, 50 pounds K_2O, 3000 pounds lime and 20 pounds borax per acre. On March 2, 1950, 30 pounds sericea lespedeza per acre was broadcast with a hand seeder in the crimson clover and covered by light harrowing. Since the sericea lespedeza planting resulted in a poor stand, the plots were reseeded in a different manner during 1951. On April 14, 1951, 40 pounds sericea lespedeza was broadcast with a wheelbarrow seeder on a prepared seedbed. Thirty pounds inoculated Dixie reseeding crimson clover was broadcast with a cyclone hand seeder in the sericea lespedeza on October 13, 1951. Satisfactory stands of both sericea and crimson clover were secured from these seedings, but the stands did not continue to be satisfactory which was probably due to competition from invading native grasses and failure of the crimson clover to properly reseed. The two-year average cost of labor, seed and fertilizer per acre was $52.89.

Another succession of annual crops included crimson clover and ryegrass for fall and winter grazing followed by grain sorghum or tift sudan for spring and summer grazing. Plots 5, 7 and 17 were seeded to 30 pounds inoculated Dixie reseeding crimson clover and 15 pounds domestic ryegrass per acre between November 18 and December 4, 1949. The ryegrass was sown with a grain drill followed immediately by clover sown with a wheelbarrow seeder. Cultipacking followed seeding in order to cover the seed. One hundred pounds P_2O_5, 50 pounds K_2O, 3000 pounds lime and 20 pounds borax were applied per acre prior to seeding.

Beginning with the 1950-51 planting and each year thereafter, an application of 60 pounds nitrogen per acre was made at seeding and repeated in January or early February. This nitrogen fertilization was made because it was doubtful if the crimson clover fixed sufficient nitrogen to be of any value to the ryegrass. After grazing of the crimson clover and ryegrass was discontinued, the plots were prepared each year and seeded to the summer annual grazing crop.

On June 5, 1950, 10 pounds of grain sorghum per acre was drilled in 42-inch rows. An application of 60 pounds nitrogen was made at seeding. Since digestive disturbances and low palatability were observed when grazing the grain sorghum, 20 pounds tift sudan per acre was substituted as the summer grazing crop during the ensuing years of the study. The tift sudan was sown with a grain drill and cultipacking followed. Biennial applications of 100 pounds P_2O_5 and 50 pounds K_2O were made on these plots. The three-year average cost for this combination was $53.75 per acre.

A hand cyclone seeder was used to seed 15 pounds per acre of Johnson grass on the prepared seedbeds of plots 6, 8 and 16. Immediately after the Johnson grass was sown, 8 pounds of inoculated Kenland red clover was seeded per acre on the same plots using a wheelbarrow seeder. Cultipacking followed seeding. This combination was seeded between February 21 and March 2, 1950. An application of 100 pounds P_2O_5, 50 pounds K_2O, 3000 pounds lime and 20 pounds borax was made per acre. A maintenance application of 100 pounds P_2O_5 and 50 pounds K_2O was made biennially. Two seedings of Johnson grass and four seedings of red clover were made before good stands were secured. The three-year average cost of this pasture combination was $43.05 per acre.

Grazing Data on the Various Plots

The stage of plant development when grazing began was about the same each year for the various pasture crops. The extent to which year around grazing was available, as indicated by the grazing dates, standard cow-days, and carrying capacity for each of the pasture treatments is indicated in Table 4. Dallis grass and white dutch clover provided grazing over a longer period of time than any other combination studied. It provided an average of 187 days grazing throughout the three years and gave a range of actual days grazing from 161 to 210 days. In general, this combination supplied grazing from the first of April to the middle of October. The white dutch clover stand became progressively poorer each year and supplied only a small part of the grazing early and late in the season.

Grazing of the annual winter crops (oats and ryegrass-crimson clover) began about mid-March and continued to the middle of May. Maximum grazing was usually afforded in April and was greatly influenced by climatic conditions. During 1951, limited grazing was obtained on oats from November 11 to December 15. As a rule, however, climatic conditions during the establishment and early development of the winter grazing crops were such that limited grazing was not available until February or March. Oats furnished grazing for an average of 78 days over a three-year period in contrast to 71 days furnished by ryegrass-crimson clover.

The annual summer grazing crops (pearl millet and grain sorghum or tift sudan) generally gave grazing from July 1 to September 1. The period of maximum grazing was variable depending upon rainfall and was usually in early August. The number of days grazed was essentially the same for pearl millet (54 days three-year average) and tift sudan (two-year average of 55 days).

Table 4: Periods of grazing, actual days grazed, standard cow-days per acre, and daily carrying capacity per acre of the pastures by years and the average.

	Period of Grazing*		Actual No. Days Grazed**	Standard Cow-Days Per Acre	Daily Carrying Capacity Per Acre
	Date Begun	Date Ended			
Dallis Grass	April 15, 1950	November 11, 1950	191	159.89	.84
and	March 24, 1951	October 20, 1951	210	157.21	.75
White Dutch Clover	March 29, 1952	October 4, 1952	161	72.93	.45
3 Year Average	April 4	October 23	187	130.01	.68
	May 27, 1950	September 15, 1950	103	82.75	.80
Alfalfa	April 5, 1952	August 23, 1952	91	104.28	1.14
2 Year Average	May 1	September 4	97	93.52	.97
	April 15, 1950	May 26, 1950	42	47.85	1.14
	March 24, 1951	May 19, 1951	56	56.02	1.00
Oats	November 11, 1951	May 20, 1952	136	99.36	.73
3 Year Average	January 18	May 22	78	67.74	.96
	July 1, 1950	September 15, 1950	77	78.79	1.02
Millet	June 30, 1951	August 20, 1951	50	74.49	1.49
	July 5, 1952	August 30, 1952	35	41.59	1.19
3 Year Average	July 2	September 2	54	64.96	1.23
Oats-Millet Combination 3 Year Average			132	132.70	1.10
Sericea Lespedeza	April 15, 1950	October 14, 1950	161	131.94	.82
and Reseeding					
Crimson Clover	March 22, 1952	October 4, 1952	161	151.51	.94
2 Year Average	April 3	August 1	161	141.72	.88
Ryegrass	April 15, 1950	June 12, 1950	44	54.40	1.24
and	March 24, 1951	May 19, 1951	56	46.95	.84
Crimson Clover	February 9, 1952	May 31, 1952	112	130.76	1.17
3 Year Average	March 15	June 1	71	77.37	1.08
Grain Sorghum	August 19, 1950	October 16, 1950	49	51.86	1.06
Tift Sudan	July 7, 1951	September 21, 1951	76	92.42	1.22
Tift Sudan	July 5, 1952	September 6, 1952	35	55.42	1.58
3 Year Average	July 27	September 26	53	66.57	1.29
Ryegrass-Crimson Clover and Grain Sorghum or Tift Sudan Combination 3 Year Average			124	143.94	1.18
Johnson Grass	June 3, 1950	October 6, 1950	119	61.16	.51
and	June 3, 1951	October 10, 1951	64	43.69	.68
Red Clover	April 26, 1952	August 30, 1952	84	75.79	.90
3 Year Average	May 15	September 19	89	60.21	.70

*Grazing was not continuous; date begun represents the earliest date any replicate was grazed and date ended represents latest date any replicate was grazed.

**Annual average of the three replicates for each pasture crop combination.

When the annual winter and summer grazing crops are combined in a three-year average, oats, followed by millet, provided an average of 132 days grazing. Ryegrass-crimson clover, followed by grain sorghum or tift sudan, furnished an average of 124 days grazing.

Results obtained from the crimson clover - sericea lespedeza combination are not accurate because of a poor stand of serecia and the abundant invasion by native grasses together with inadequate reseeding of the crimson clover. The average days of grazing afforded by this combination on a two-year basis was 161. During the spring, crimson clover provided some grazing; however, most of the grazing was provided by invading native grasses and irregular stand of sericea lespedeza.

Despite poor stands and insect damage, the alfalfa plots furnished a two-year average of 97 days grazing. Excellent grazing was available on these plots during April. During May, grazing was rather limited; however, in late May, available forage increased considerably and remained relatively good until July. No difficulty was encountered with bloat while grazing the alfalfa plots.

Johnson grass and red clover furnished some grazing from the middle of May until mid-September. This combination provided an average of 89 days grazing for the three-year experimental period. The wide range in actual days grazed of 64 to 119 days was due primarily to differences in stands of these two crops.

The standard cow-day provides an evaluation of the various pasture combinations in terms of yields of digestible nutrients. The standard cow-days, actual grazing dates and carrying capacity for each pasture combination are presented in Table 4. It is interesting to note that ryegrass-crimson clover, followed by grain sorghum or tift sudan, provided the highest average of standard cow-days per acre. The three-year average for this succession of annual crops was 143.94. A close second was the crimson clover sericea lespedeza combination which provided a two-year average of 141.72 standard cow-days. As indicated previously, much of the grazing afforded by this combination was actually from invading native grasses rather than the seeded combination. Oats, followed by pearl millet, ranked third by providing an average of 132.70 standard cow-days. Dallis grass-white dutch clover ranged from 72.93 to 159.89 and averaged 130.01 standard cow-days. The other combinations studied were considerably lower in standard cow-days provided due to difficulties in establishing and maintaining good stands.

Daily carrying capacity in cows per acre gives a more critical evaluation of the various pasture combinations than actual days grazed or standard cow-days because it includes the forage yield as well as the length of time grazed. The pasture combinations of a succession of annual crops had the highest daily carrying capacity. The average daily carrying capacity for the various combinations was as follows: ryegrass-crimson clover, followed by grain sorghum or tift sudan, 1.18; oats, followed by millet, 1.10; alfalfa .97; crimson clover sericea lespedeza .88; Johnson grass-red clover .70; and, Dallis grass-white dutch clover .68.

Total Digestible Nutrients and Milk Production Obtained From Pasture

A general summary of the yearly concentrate consumption, body weight changes, milk production, nutrient requirements for maintenance and milk production, and the percentage total digestible nutrients obtained from the various pastures is presented in Table 5. Considerable variation appears in the yield of 4 percent fat-corrected milk and total digestible nutrients obtained per acre from year to year with all of the pasture crops studied. Two of the most important causes of the variations in crop yields were temperature and moisture conditions. The most characteristic feature of precipitation during the period of this experiment was its irregularity from month to month and from season to season in respect to time and degree of occurrence (Table 2). For plants growing in heavy soils

Table 5. Summary of milk production, body-weight changes, nutrients supplied by pasture, concentrate consumption and grain-milk ratio per acre by years and the average.

Crop	Year	Total 4% F. C. M. Produced (Pounds)	4% F. C. M. Credited to Pasture (Pounds)	Body Weight Gain (+) or Loss (—) (Pounds)	Total T. D. N. Required (Pounds)	Percent T. D. N. Credited to Pasture	Concentrate Fed (Pounds)	Grain-Milk Ratio
Dallis Grass and White Dutch Clover	1949-50	5049.8	3822.7	+130.6	3379.6	75.7	1171.0	1:4.3
	1950-51	5830.5	3923.9	+140.5	3737.5	67.3	1805.4	1:3.2
	1951-52	3597.7	2151.4	+ 28.3	1951.4	59.8	1065.3	1:3.4
	3 Yr. Avg.	4826.0	3298.3	+ 99.8	3022.8	67.6	1347.2	1:3.6
Alfalfa	1949-50	3220.4	2312.2	+ 43.4	1844.0	71.8	740.1	1:4.4
	1951-52	4161.7	2759.2	+ 32.7	2516.6	66.3	1137.5	1:3.6
	2 Yr. Avg.	3691.0	2535.7	+ 38.0	2180.0	69.0	938.8	1:4.0
Oats	1949-50	1722.3	1369.2	+ 27.6	963.0	79.5	293.3	1:5.9
	1950-51	2013.7	1468.0	+ 59.8	1246.7	72.9	481.8	1:4.2
	1951-52	3633.0	2506.8	+ 40.0	2304.0	69.0	1016.4	1:3.6
	3 Yr. Avg.	2456.3	1781.3	+ 42.5	1504.6	73.8	597.2	1:4.6
Millet	1949-50	2905.4	2051.2	+ 51.9	1785.5	70.6	726.1	1:4.0
	1950-51	2465.8	1837.0	+200.2	1599.8	74.5	568.7	1:4.3
	1951-52	1894.7	1245.8	— 38.3	1013.0	65.7	478.0	1:4.0
	3 Yr. Avg.	2422.0	1711.3	+ 71.3	1466.1	70.3	590.9	1:4.1
Oats-Millet (Combination)		4878.3	3492.6	+113.8	2970.7	72.0	1188.1	1:4.4
Johnson Grass and Red Clover	1949-50	2677.3	1745.6	+ 34.4	1500.8	65.2	740.3	1:3.6
	1950-51	1534.0	1031.3	+ 20.9	1040.2	67.2	462.2	1:3.3
	1951-52	3747.8	2304.3	— 33.5	1971.7	61.5	1019.8	1:3.7
	3 Yr. Avg.	2653.0	1693.7	+ 7.3	1504.2	64.6	740.8	1:3.5
Sericea Lespedeza and Crimson Clover	*1949-50	4251.6	3201.4	+ 99.2	2803.6	75.3	797.9	1:5.3
	*1951-52	6006.1	4143.6	+159.5	3911.7	69.0	1641.0	1:3.7
	2 Yr. Avg.	5128.8	3672.5	+129.4	3357.6	72.2	1219.4	1:4.5
Ryegrass and Crimson Clover	1949-50	1966.7	1555.6	+ 15.9	1100.5	79.1	342.0	1:5.8
	1950-51	1708.1	1200.9	+ 38.4	1068.5	70.3	447.9	1:3.8
	1951-52	4464.0	3139.1	+113.7	2976.1	70.3	1209.2	1:3.7
	3 Yr. Avg.	2712.9	1965.2	+ 56.0	1715.0	73.2	666.4	1:4.4
Grain Sorghum or Tift Sudan	1949-50	1953.3	1285.2	+ 45.5	1260.9	65.8	598.8	1:3.3
	1950-51	2972.2	2174.1	+107.6	2022.8	73.1	801.9	1:3.7
	1951-52	2741.5	1789.4	— 79.8	1358.0	65.3	649.5	1:4.2
	3 Yr. Avg.	2555.7	1749.6	+ 24.4	1547.2	68.1	683.4	1:3.7
Ryegrass-Crimson Clover and Grain Sorghum or Tift Sudan (Combination)	3 Yr. Avg.	5268.6	3714.8	+ 80.4	3262.2	70.6	1349.8	1:4.0

* Spring grazing largely from crimson clover and summer grazing largely from native grasses rather than Sericea lespedeza.

with low permeability, the prevailing soil type in these plots, the periodic distribution of rainfall may be more important than the total annual precipitation. During the growing season, a span of several days without rain tended to retard growth of the crops. Obviously, then, the monthly distribution, as given in Table 2, covers too long a period to indicate fully the effect of distribution on pasture yields. Even though the average total annual rainfall was higher during the experimental years than the 20-year average preceding the experiment, the distribution was poor. The yield of the summer grazing crops during 1952 was materially reduced because of the prolonged drouth.

In addition, seasonal and monthly temperature variations affect not only the length of the growing period, but also the rate of growth. With winter grazing crops, periods of warm weather during December, January and February stimulated growth, but maximum growth was not attained until after the last killing frost in the spring (Table 1).

The Dallis grass-white dutch clover pasture was credited with a maximum yield of 3923.9 pounds 4 percent fat-corrected milk in 1951 and with only 2151.4 pounds per acre in 1952. The three-year average of this combination was 3298.3 pounds 4 percent fat-corrected milk. Pasture furnished 67.6 percent of the total digestible nutrients required by the cows. The low yield during 1952 was due primarily to low rainfall as well as invasion of less desirable plants.

A three-year average of 1781.3 pounds 4 percent fat-corrected milk per acre was obtained from oats grazed in the winter. The range in pounds of 4 percent fat-corrected milk from oats was from a high of 2506.8 for 1951-52 to a low of 1369.2 for the winter of 1949-50. Oats produced 73.8 per cent of the total nutrients required by the grazing cows. A direct relationship was observed between the earlier fall plantings and a longer winter grazing season resulting in higher yields. However, when late summer and early fall plantings of oats were made, considerable difficulty was encountered with army worms which necessitated spraying in order to retain suitable stands.

Pearl millet, which followed the oats for summer grazing, gave a three-year average yield of 1711.3 pounds of 4 percent fat-corrected milk. This yield was equivalent to 70.3 percent of the total nutrient requirements of the cows. Three years' grazing data on the millet showed that most of the nutrient yield was obtained during a short time in the first part of the grazing period and that a very limited amount of grazable forage was provided during the last part of the grazing period. When the three-year yields of oats and millet were combined as a succession of annual grazing crops, this combination yielded an average of 3492.6 pounds 4 percent fat-corrected milk per acre annually.

The other winter grazing combination made up of ryegrass and reseeding crimson clover yielded an average of 1965.2 pounds 4 percent fat-corrected milk per acre yearly over the three-year period with a range of 1200.9 pounds in 1950-51 to 3139.1 pounds in 1951-52. An average of 73.2 percent of the nutrients was obtained from grazing. Like oats, most of the grazing was obtained during late winter and early spring. The wide range in yield variations from year to year with this combination were likely due to the application of 60 pounds nitrogen per acre at seeding and again in late January or early February in the last two years of the experiment as well as the difficulty encountered in maintaining a satisfactory stand of crimson clover in the heavy clay soils with poor internal drainage. During the summer of 1950, grain sorghum was used as the temporary summer grazing crop following the ryegrass-crimson clover. Because of low yields (only 1285.2 pounds 4 percent fat-corrected mlik), digestive disturbances, and low palatability, the grain sorghum was replaced with tift sudan for the 1951 and 1952 summers. An average of 1981.7 pounds of 4 percent fat-corrected milk per acre was credited to the tift sudan over a two-year period. No rust was observed with the tift variety of sudan. In contrast to millet, which gave a high forage yield for a relatively short period, sudan gave a higher yield which was more evenly distributed throughout the length of the grazing period. On a three-year basis, the ryegrass-crimson clover, followed by grain sorghum or tift sudan, yielded an average of 70.6 percent of the nutrient requirements for maintenance and milk production. An average of 3714.8 pounds of 4 percent fat-corrected milk was credited annually to this succession of annual crops to give this combination first place in milk production per acre.

It has been difficult to maintain a stand of crimson clover and to obtain a uniform stand of sericea lespedeza in the Post Oak Prairie area of the Blackbelt region. The 3672.5 pounds 4 percent fat-corrected milk per acre credited to the crimson clover sericea lespedeza combination measured not only crimson clover and serecia, but also abundant invasion of native grasses (Dallis grass and Bermuda prevailing). Consequently, extreme caution must be exercised in evaluating this combination from the data presented.

The results obtained from grazing alfalfa are not considered a reliable measure of its value because of partial stands in the earlier years and insect damage in the later years. The yield of 2312.2 pounds 4 percent fat-corrected milk per acre for 1949-50 is from grazing about one-half of a stand of alfalfa in the summer of 1950. The 66.3 percent of nutrients credited to alfalfa during 1951-52 was obtained largely from excellent grazing in the early part of the 1952 grazing season. Dry weather (Table 2) and insect damage reduced grazing sharply during the latter part of the 1952 grazing season.

The three-year average yield in pounds of 4 percent fat-corrected milk from the combination of Johnson grass and red clover of 1693.7 was the lowest of the pasture combinations studied. This low yield, which is not considered a reliable measure of the combination, was due largely to extremely poor stands. At no time during the three-year experimental period was there a full and uniform stand of both of these crops simultaneously on all three plots. The milk production and total digestible nutrient yields varied widely between the plots and were directly proportional to the percentage stands of these two crops. A much better stand was maintained on plot 16 which was better adapted to these crops. The average yield for the three years on plot 16 was 2088 pounds 4 percent fat-corrected milk per acre with a range of 1501.5 pounds in 1950-51 to 4560.9 pounds in 1951-52. These data on plot 16 were included to give a clearer and more accurate appraisal of the value of Johnson grass-red clover as a pasture than could be obtained from the combined averages of the three plots seeded to this combination.

The grain-milk ratio presented in Table 5 indirectly indicates the variations in quality of a particular pasture from year to year. In addition, this ratio gives a relative idea of the variation in quality between the various pasture combinations. In general, the wider the grain-milk ratio, the higher the quality of the pasture. The cows grazed on the various pastures maintained or gained in body weight throughout the experiment except during the summer of 1952 when slight body weight losses occurred while grazing the annual summer crops and the Johnson grass-red clover combination, and during the late fall of 1951 while grazing oats. It is noteworthy, regardless of the pasture crop, that those pastures grazed in the late winter and spring months furnished a higher percentage of the nutrient requirements of the cows than those pastures grazed during the hot summer months.

Monetary and Feed Replacement Value of the Various Pastures

Annual and average costs, returns and lespedeza hay equivalents for each of the six pasture combinations are shown in Table 6. The methods of computing the costs, value of the milk as Grade A or manufacturing milk, and lespedeza hay equivalents have previously been presented.

The Dallis grass-white dutch clover combination produced milk at the lowest average feed cost, $1.56 for each

Table 6. Net value of milk produced per acre above the cost of grain fed and the cost of pasture treatments and the lespedeza hay equivalent by years and the average.

Crop	Year	Concentrate Cost	Pasture Cost	Total Feed Cost	Value of Milk		Total Feed Cost Per 100 lb. 4% F.C.M.	Net Value of Milk Above Total Feed Cost		Lespedeza Hay Equivalent in Pounds
					Grade A	Mfg. Milk		Grade A	Mfg. Milk	
Dallis Grass	1949-50	$43.91	$52.94	$ 96.85	$270.16	$176.74	$1.92	$173.31	$ 79.89	5386
and	1950-51	67.70	7.00	74.70	311.93	204.07	1.28	237.23	129.37	5295
White Dutch Clover	1951-52	39.95	13.42	53.37	192.48	125.92	1.48	139.11	72.55	2457
	3 Yr. Avg.	50.52	24.45	74.97	258.19	168.91	1.56	183.22	93.94	4379
	1949-50	27.75	66.47	94.22	172.29	112.71	2.92	78.07	18.49	3882
Alfalfa	1950-51		23.36*							
	1951-52	42.66	41.20	107.22	222.65	145.66	2.58	115.43	38.44	5298
	2 Yr. Avg.	35.20	65.52	100.72	197.47	129.19	2.75	96.75	28.47	4590
	1949-50	11.00	36.99	47.99	92.14	60.28	2.79	44.13	12.29	1612
Oats	1950-51	18.07	24.61	42.68	107.73	70.48	2.12	65.05	27.80	1913
	1951-52	38.12	41.66	79.78	194.37	127.16	2.20	114.59	47.38	3347
	3 Yr. Avg.	22.40	34.42	56.82	131.41	85.97	2.37	74.59	29.15	2291
	1949-50	27.23	27.05	54.28	155.44	101.69	1.87	101.16	47.41	2654
Millet	1950-51	21.32	19.07	40.39	131.92	86.30	1.64	91.53	45.91	2509
	1951-52	17.93	19.76	37.69	101.37	66.31	1.99	63.68	28.62	1401
	3 Yr. Avg.	22.16	21.96	44.12	129.58	84.77	1.83	85.46	40.65	2188
Oats-Millet (Combination)		44.56	56.38	100.94	260.99	170.74	2.10	160.05	69.80	4479
Sericea Lespedeza	1949-50	29.92	59.41	89.33	227.46	148.81	2.10	138.13	59.48	4444
and	1950-51		16.67*							
Crimson Clover	1951-52	61.54	29.71	107.92	321.33	210.21	1.79	213.41	102.29	5682
	2 Yr. Avg.	45.73	52.89	98.62	274.40	179.51	1.94	175.78	80.89	5051
Ryegrass	1949-50	12.83	42.98	55.81	105.22	68.83	2.84	49.41	13.02	1833
and	1950-51	16.80	12.90	29.70	91.38	59.78	1.74	61.68	30.08	1581
	1951-52	45.35	47.34	92.69	238.82	156.24	2.08	146.13	63.55	4405
Crimson Clover	3 Yr. Avg.	24.99	34.41	59.40	145.14	94.95	2.22	85.74	35.55	2606
	1949-50	22.46	21.74	44.20	104.50	68.37	2.26	60.30	24.17	1747
Grain Sorghum	1950-51	30.07	17.47	47.54	159.01	104.03	1.60	111.47	56.49	3113
Tift Sudan	1951-52	24.36	18.80	43.16	146.67	95.95	1.57	103.51	52.79	1867
Tift Sudan	3 Yr. Avg.	25.63	19.34	44.97	136.73	89.45	1.81	91.76	44.48	2242
Ryegrass-Crimson Clover and Grain Sorghum or Tift Sudan (Combination)	3 Yr. Avg.	50.62	53.75	104.37	281.87	184.40	2.02	177.50	80.03	4848
Johnson Grass	1949-50	27.76	59.01	86.77	143.23	93.71	3.24	56.46	6.94	2060
and	1950-51	17.33	36.82	54.15	82.07	53.69	3.53	27.92	—.46	1472
Red Clover	1951-52	38.24	33.32	71.56	200.50	131.17	1.91	128.94	59.61	2553
	3 Yr. Avg.	27.78	43.05	70.83	141.93	92.86	2.89	71.10	22.03	2028

*Costs for this year were added to the following year and averages for these two treatments are on a two-year basis.

100 pounds 4 percent fat-corrected milk. This was partially due to the lowest average pasture cost $24.45 per acre of any combination, but was also influenced by the high milk production on this combination during 1949-50 and 1950-51. The difficulties encountered in maintaining a stand of white dutch clover and controlling weeds in these plots are brought out by the decrease in returns in 1951-52.

The oats and millet combination and the ryegrass-crimson clover and grain sorghum or tift sudan combination compared very favorably with Dallis grass-white dutch clover in value of milk produced above the total feed cost even though the feed cost per 100 pounds 4 percent fat-corrected milk was considerably higher, $2.10 and $2.02, respectively, per 100 pounds compared to $1.56 on Dallis grass-white dutch clover. The higher feed cost per 100 pounds milk produced was due primarily to high seed, labor and fertilizer costs on these annual crops. This difference, in part, was offset in total returns above feed cost by the higher total milk production and lower rate of concentrate feeding on these high quality grazing crops. The data in Table 6 under grain sorghum or tift sudan are for grain sorghum in 1949-50 and tift sudan in 1950-51 and 1951-52. A comparison of the data for the three years show that milk production was higher and pasture cost lower for tift sudan than for grain sorghum, resulting in higher returns and lower feed cost. Thus, the three-year average shown is less favorable to tift sudan than a two-year average, excluding grain sorghum, would be. When tift sudan is compared with pearl millet on the basis of two years' data, the tift sudan has the higher average return above feed cost, $107.49, compared to $77.60 on a Grade A basis and the lower feed cost per 100 pounds of 4 percent fat-corrected milk, $1.59 to $1.82. This fairly large difference in value of milk above feed cost and relatively small difference in feed cost per 100 pounds of 4 percent fat-corrected milk is due to production of more total milk per acre on tift sudan and a higher pasture cost on millet.

The average returns from the oats and ryegrass-crimson clover plots as winter grazing crops were unfavorably influenced by late seeding (Table 3) and adverse climatic conditions (Tables 1 and 2) in two of the three years for which data are presented. The layout of the plots was not completed in sufficient time to permit seeding these winter grazing crops prior to November 17 to 25, 1949. In 1950, the oats and ryegrass-crimson clover were seeded in October and were severaly damaged by a hard freeze in late November. These unfavorable conditions for the first two years are reflected in much lower returns above feed cost for 1949-50 and 1950-51 than for 1951-52. The original plan was to seed reseeding crimson clover with the ryegrass and depend on its reseeding to maintain the stand. A good stand of crimson clover was present in the ryegrass in the spring of 1950 from the November 1949 seeding but very little crimson clover was present in these plots during the 1950-51 grazing season. In the fall of 1951, the crimson clover was reseeded, resulting in a good ryegrass-crimson clover mixture for the 1951-52 grazing period. The absence of crimson clover and the late seeding of the ryegrass were contributing factors in the low returns from this combination in 1950-51.

The difficulties encountered in establishing and maintaining stands in the alfalfa, the lespedeza sericea-crimson clover and the Johnson grass-red clover combinations greatly increased the cost and reduced returns from these crops. If the cost of the frost-killed seedings of alfalfa prior to the August 1951 seeding are disregarded and only the cost of this seeding considered with the 1951-52 returns, alfalfa returned $138.79 per acre as Grade A milk above total feed cost at a feed cost of $2.01 per 100 pounds 4 percent fat-corrected milk. This compares very favorably with the average returns and feed cost per 100 pounds milk for Dallis grass and white dutch clover considering the fact that there was an excellent stand of alfalfa to be grazed in 1953 with only a very small pasture maintenance charge to be made against it.

One of the most practical ways of expressing the returns from pasture is as hay equivalent. Lespedeza hay was chosen, rather than alfalfa, which is generally used, because lespedeza hay is more commonly produced and fed by Mississippi dairymen. The annual and average lespedeza hay equivalents for the various pastures in pounds per acre are presented in Table 6.

The high lespedeza hay equivalent, average of 5051 pounds per acre for two years, for the lespedeza sericea-crimson clover combinations was largely from heavy yields of two first year seedings of crimson clover in the spring of 1950 and 1952 and from volunteer native grasses and white dutch clover in these plots after the crimson clover was mature. There was very little lespedeza serecia present in these plots while they were being grazed. As suggested previously, caution must be exercised in interpreting the returns from this combination.

The succession of annual grazing crops produced a slightly higher lespedeza hay equivalent than did the Dallis grass-white dutch clover combination. Ryegrass and crimson clover, followed by grain sorghum or tift sudan, yielded an average lespedeza hay equivalent of 4848 pounds and oats, followed by millet, averaged 4479 pounds. In comparison, Dallis grass-white dutch clover produced an average lespedeza hay equivalent of 4379 pounds per acre annually.

The expression of pasture values in dollars is of only temporary application because of changing prices and circumstances. Even though changes in the prices of milk and in concentrate and pasture costs will greatly change the feed cost per 100 pounds of milk and the value of the milk above feed cost, the relation of these values between crops will not be greatly affected because the costs and returns for the different pasture combinations are based on the same cost and price data. In applying the data presented in Table 6 to individual circumstances, changes in milk prices and feed and pasture costs from those prevailing while this trial was conducted should be given careful consideration. In addition, the effects of poor stands, late seedings and unusual climatic conditions discussed elsewhere in this publication should be taken into account in deciding what pasture crops might be most profitable under a different set of conditions.

SUMMARY

Eighteen plots of two acres each, located on typical Post Oak Prairie land, were seeded to various pasture crop combinations and grazed with milking cows to determine the possibility of providing year-around pasturage and to determine the relative economy of the various pasture crops as sources of nutrients for milk production.

Six pasture crop combinations, replicated three times, were grazed over a period of three years. The pasture crop combinations used were (1) Dallis grass and white dutch clover, (2) alfalfa, (3) annual crop succession of oats, followed by millet, (4) reseeding crimson clover and sericea lespedeza, (5) a combination of reseeding crimson clover and ryegrass, followed by grain sorghum or tift sudan, and (6) Johnson grass and red clover. Plant nutrients were supplied in the form of individual plant food elements and at a rate and frequency based on soil analysis and agronomic recommendations.

Concentrates were fed to the grazing cows according to milk production. The stocking rate was varied according to available forage.

Pasture yields were measured in terms of 4 percent fat-corrected milk, grain or loss in body weight and total digestible nutrients derived from pasture. Considerable variation occurred in the yields of 4 percent fat-corrected milk and the total digestible nutrients per acre from year to year with all of the pasture crop combinations. It appeared that temperature and rainfall were the principal factors causing yield variations of the same crop.

The highest average annual yield of 4 percent fat-corrected milk credited to pasture was obtained from the combination of ryegrass and crimson clover, followed by grain sorghum or tift sudan. The average yield of this succession of annual crops amounted to 3714.8 pounds of 4 percent fat-corrected milk per acre annually.

The average percent of the total digestible nutrient requirements of the grazing cows obtained from the various pasture crop combinations ranged from 64.6 percent for Johnson grass and red clover to 72.2 percent for the sericea lespedeza-crimson clover combination.

The combination of Dallis grass and white dutch clover provided grazing over a longer period than any other combination studied. However, despite a shorter grazing period, the pasture combinations involving a succession of annual crops produced more 4 percent fat-corrected milk per acre and compared favorably with Dallis grass and white dutch clover in total digestible nutrient production and income above feed cost per acre.

The Dallis grass-white dutch clover combination produced milk at the lowest average feed cost per 100 pounds 4 percent fat-corrected milk. The succession of annual crops compared favorably with Dallis grass-white dutch clover in value of milk produced above feed cost even though the feed cost per 100 pounds 4 percent fat-corrected milk was considerably higher. The higher feed cost for each 100 pounds milk produced from the annual crops was due to the necessity of seedbed preparation, seeding and fertilization for each crop produced. These higher feed costs on the annual cropping combinations were counteracted by higher total milk production and lower rates of concentrate feeding due to the high quality grazing afforded.

In making application of the results presented to individual circumstances, changes in milk prices and feed and pasture costs from those prevailing while this trial was conducted should be carefully evaluated. In addition, the effect of poor stands and unusual climatic conditions should be considered in deciding what pasture crops might be most profitable under a different set of conditions.

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BULLETIN 508 JANUARY, 1954

The Cotton Plantation in Transition

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AGRICULTURAL EXPERIMENT STATION
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TABLE OF CONTENTS

Page

Introduction 3

Case Study Plantations 4

Housing the Plantation Workers 6

Plantation Management 11

Tenure Arrangements 15

Skilled Workers 16

Machines Vs. Mules 18

Land Use 20

Summary and Conclusions 24

Department of Sociology and Rural Life
MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
in cooperation with
Bureau of Agricultural Economics
United States Department of Agriculture

THE COTTON PLANTATION IN TRANSITION

The Case Studies of a Mechanized and An Unmechanized Cotton Plantation In the Yazoo-Mississippi Delta

By
Harald A. Pedersen and Arthur F. Raper*

The casual observer driving through the Yazoo-Mississippi Delta will be impressed with the fact that though the old ways of life still obtained new ways are becoming increasingly apparent. The mid-summer tourist traveling along US 61 from Memphis to Vicksburg or on US 82 from Greenwood to Greenville may well see four or five self-propelled combines moving through a field of grain on the right and a hundred or more field hands with hoes, seemingly stationary by comparison, in the cotton field to the left. In late summer and fall the mechanical cotton pickers replace the combines and the cotton sacks replace the hoe, but men and machines still work side by side.

These are the outward and visible signs of transition in the Yazoo-Mississippi Delta. Less obvious, but nonetheless real, is the change in the attitudes in plantation operators and plantation workers. The value system which has characterized the culture of the area for generations is being changed. The planter's wife complains that there are no new recruits among the plantation labor families to take over the jobs of the aging domestics. The domestic in the big house no longer enjoys the prestige of yesterday among his fellow workers. The tractor driver has failed to attain prestige in the occupational hierarchy of the plantation labor force. Planter after planter complains that though the drivers are paid well there is no rush for the jobs.

Yes, the Delta is in transition. This is in evidence when looking at the new machines and the old tenant houses, when listening to the plantation owner talk about his operations today and his hopes for tomorrow and when listening to the conversation of the plantation folk around the store and filling station or on the street corner.

The old has not yet gone and the new has not fully arrived. The mixture of the old and the new is the thing. This mixture bids fair to remain prevalent until some sure method other than hand labor is developed for the control of weeds and grass in growing cotton.

There is still considerable hesitancy in the matter of using machines. The mechanical picker can operate well only when the ground is dry, when weeds and grass are under control, when the cotton is defoliated and when the fields are large and regular enough. The planter is torn between conflicting objectives and irreconcilable operating alternatives. Time and again planters have remarked, "If the kind of labor we had twenty years ago were available today they could keep all their machinery."

The plantation is a social institution which is characterized by primary or "face-to-face" relations. The "good" worker, good both in terms of production and in terms of his relations to the boss and to his fellow workers, is rewarded with better land to work and more off-season employment around the plantation. He also is assured of a house to live in and odd jobs around the place when he is too old or otherwise unable to work in the fields. The plantation is an institution in which traditional controls are dominant.

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The plantation is also an economic institution which is dependent on a highly competitive commodity for its existence. It must produce cotton at a cost that can compete with the cost of production on the world market if it is to survive. The economic and social objectives are not always in harmony and cannot necessarily be attained through the same operating policies.

The increasing scarcity of labor in the area has raised the labor cost from a dollar a day less than fifteen years ago to four dollars and more. True, the latter is an inflated dollar compared to the former but the rate of inflation is not 400 percent. Even at this higher rate the planter frequently finds himself unable to obtain labor enough to perform the essential operations during the peak work-demand periods.

The alternatives available to the planter are to reduce the acreage in cotton or increase the labor efficiency of his operation through higher capitalization in the form of mechanization. The second alternative is limited in its application by the level of technology. Weed control remains as a primary operation in cotton production for which successful technological substitutes for hand labor have not been developed. This continuing need for hoe hands limits the substitution of machines for manpower on the plantation.

The purpose of the present analysis is to describe the process of adjustment which is taking place on individual plantations in response to the challenge of mechanization and the problem of labor scarcity. The study is concerned primarily with the distribution of people on the land. This then is the story of two plantations and their people.

Case Study Plantations

The plantations selected for study represent fairly typical modes of adjustment to the changing operating situation in the Delta. The one plantation, Tractor Plantation,[1] is relatively advanced in mechanization. The other plantation, Mule Plantation, is relatively unmechanized.

The plantations are not extreme types.[2] There are plantations in the Delta that have progressed farther in the substitution of machines for human and animal labor than has Tractor Plantation. There are plantations that more nearly follow the practices of a quarter of a century ago than does Mule Plantation. There are plantations where practically all the cotton is picked with machines, where mules are never seen in the cotton fields. This is not the case on Tractor Plantation. There are plantations where all the cotton is harvested with hand labor and mechanical pickers have never been seriously considered, where a cropper family with the help of a mule "make" the cotton crop. This is not the case on Mule Plantation.

Though the two plantations are not extreme types, cotton production on Tractor Plantation is tractor oriented whereas on Mule Plantation it remains mule oriented.

Both plantations were established around the turn of the century. Mule Plantation was cut out of the swamp by the father of the present owner. The large block of land surrounding the plantation headquarters of well-drained silt loam soil, good cotton land which was seldom been planted to other crops, was acquired first (Figure 1.). Subsequently, additional "forties" were added to the east, west, and north. Some detached tracts not shown on the map complete the holding—3160 acres in all, 2700 in the home place. The track was completed prior to World War I and no land has been bought or sold since.

The sprawling profile of the unit atests to the characteristics of the planter himself. The story is told that the wife of the planter frequently sought to prevail on her husband to fill in the gaps and square out the planta-

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[1] The names by which the plantations are designated are fictitious in the interest of preserving the anonymity of the cooperators in this study.

[2] For a discussion of the tractors, mules, and heavy equipment available on each of the plantations, see the section "Machine vs. Mules."

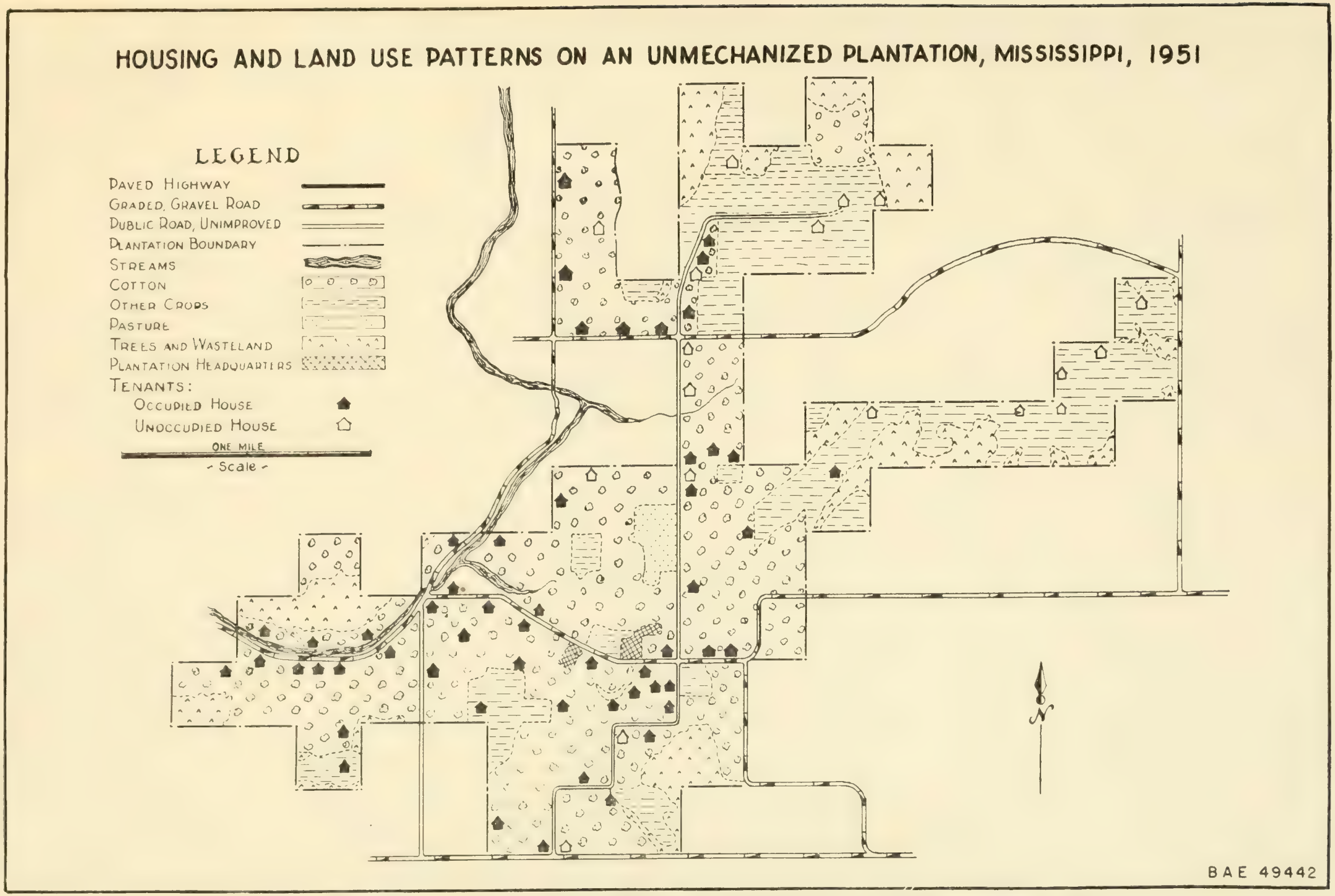
HOUSING AND LAND USE PATTERNS ON AN UNMECHANIZED PLANTATION, MISSISSIPPI, 1951
LEGEND
PAVED HIGHWAY
GRADED, GRAVEL ROAD
PUBLIC ROAD, UNIMPROVED
PLANTATION BOUNDARY
STREAMS
COTTON
OTHER CROPS
PASTURE
TREES AND WASTELAND
PLANTATION HEADQUARTERS
TENANTS:
OCCUPIED HOUSE
UNOCCUPIED HOUSE
ONE MILE
- Scale -
N
BAE 49442

Figure 1. Housing and land use on Mule Plantation, Bolivar County, Mississippi, 1951.

tion. The planter's pet response was "What would I do with the land? It's no good for cotton. Let others pay the tax on it."

Mule Plantation was and is a cotton factory and little attention is given to anything else. Livestock feed, except for scant winter grazing, was bought by the car load lot and usually the entire supply was secured in one shipment. This was a bit of bravado permitted himself by the normally conservative planter and, of course, livestock feed is cheaper by the carload lot.

Another concession, this one to sentiment, is that the track just west of the big house on the town side of headquarters has never been planted to cotton. "We don't like to see cotton growing right up to the front door."

Nevertheless, management on Mule Plantation is essentially conservative. "We don't need to try all these new ideas. We have a laboratory all around us. Let others spend their money on experiments." The previous manager took considerable kidding from the neighbors about the conservatism of his operations. His stock response when pushed too far, "Well, we can still pay our bills." The implication is obvious and frequently justified.

Management on Tractor Plantation is more aggressive, more daring, definitely not conservative. After the disastrous White River flood in Arkansas around 1880, the grandfather of the present owner crossed the river to the Mississippi side and bought two small plantations. There are three or four major cotton areas on the plantation which represent the production nucleus of the original small plantations absorbed in the operation (Figure 2).

Management on Tractor Plantation expanded the area by absorbing plantations rather than by buying cotton land as did the owner of Mule Plantation. This is largely a function of the stage in settlement of the two areas in which the plantations are located. Tractor Plantation lies on the river and has access to water transportation, which though not important today means that the area was settled earlier. Mule Plantation lies 15-20 miles inland from the river and settlement had to await the coming of railroads and other forms of transportation. The owner of Mule Plantation **could not** have developed his holdings as he did if he had settled in the area where Tractor Plantation is located. On the other hand the successive owners of Tractor Plantation **would not** have developed the holdings after the pattern of Mule Plantation had they settled in the latter area.

The present owner of Tractor Plantation gave this thumbnail sketch of the development of the holdings. "Grandfather bought up around 2500 acres. My father added another 1500, but I've managed to add only 240 acres to the plantation." There was an adjoining plantation that was bought in the early thirties and sold back a year or two later. Even today there are several farms or small plantations which seem desirable additions when and if they became available. Today the plantation contains approximately 5000 acres but the plantation area is by no means fixed and stable. The cropper supervisor remarked about a finger of land stabbing into the heart of the plantation and not owned by them "When we could buy it, **we** couldn't; and now that **we** can buy it, we can't."

The philosophy of management on Tractor Plantation is that if there is a better way to grow cotton or a more profitable crop they want to know about it, and if it looks good they will try it. Power take-off combines, self-propelled combines, mechanical cotton pickers, flame cultivators, chemical weed control are all in use or have been tried on the plantation. The owner laughingly admits that lack of sales resistance rather than sound management may have resulted in some experimentation with innovations. On the other hand, "If we don't try it we won't know if it will work for us. You have to gamble, take a calculated risk occasionally, to make progress."

Housing The Plantation Workers

The history of mechanization in the cotton fields is beclouded by the con-

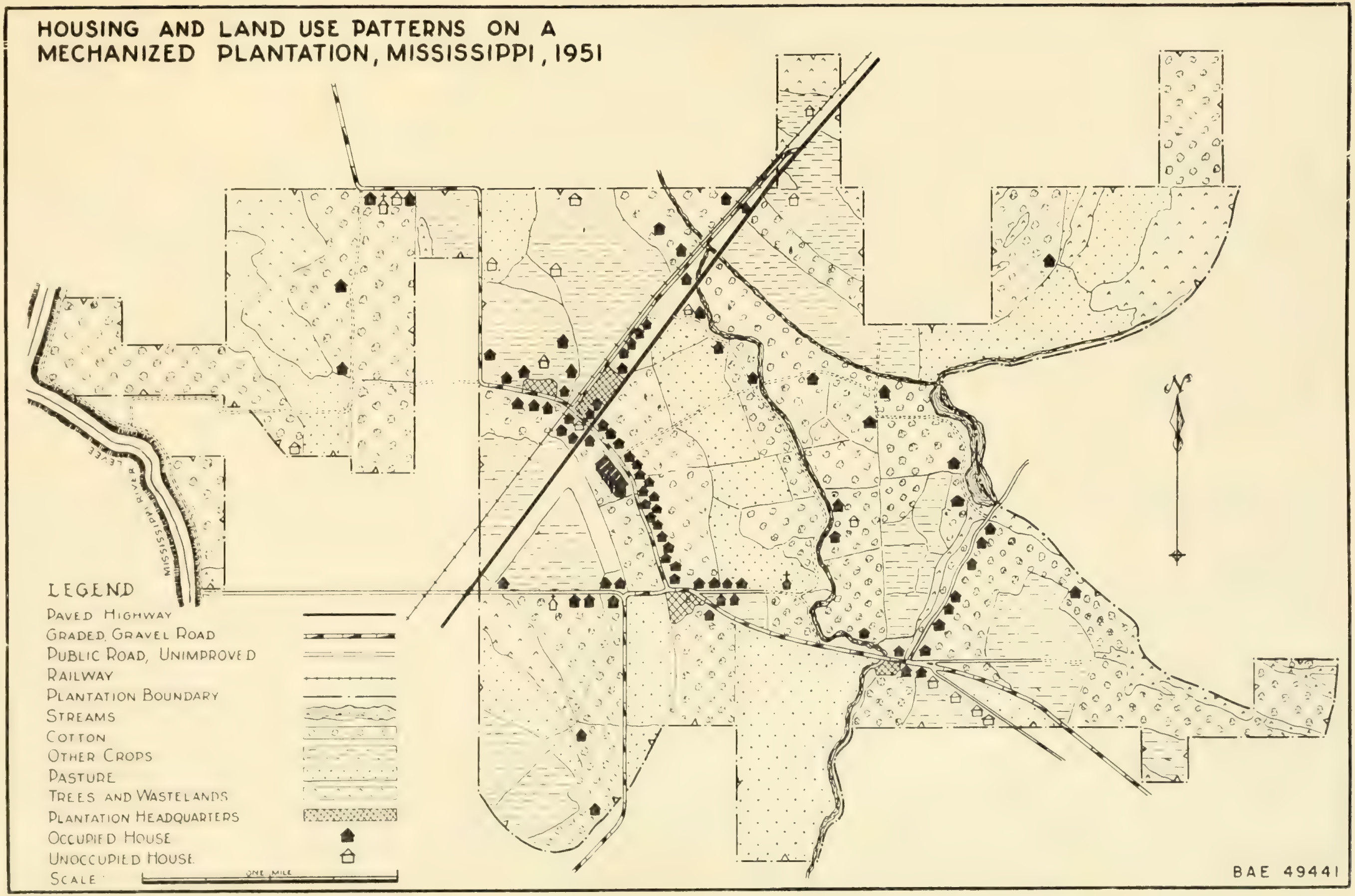
HOUSING AND LAND USE PATTERNS ON A MECHANIZED PLANTATION, MISSISSIPPI, 1951
N
MISSISSIPPI RIVER
LEVEE
LEGEND
PAVED HIGHWAY
GRADED, GRAVEL ROAD
PUBLIC ROAD, UNIMPROVED
RAILWAY
PLANTATION BOUNDARY
STREAMS
COTTON
OTHER CROPS
PASTURE
TREES AND WASTELANDS
PLANTATION HEADQUARTERS
OCCUPIED HOUSE
UNOCCUPIED HOUSE
SCALE
ONE MILE
BAE 49441

Figure 2. Housing and land use on Tractor Plantation, Bolivar County, Mississippi, 1951.

flict between the need for efficiency and the adherence to the traditional paternalism characteristic of the plantation. The people of the nation's number one problem area of a decade and a half ago, at least from the standpoint of the attention given to the area, have become acutely aware of the human element involved in the transition to mechanized operations. Illustrating this awareness, the Rust brothers withheld their patents for a mechanical picker for several years and endowed a training school for field hands with proceeds from royalties to facilitate the readjustment of the workers. Even today nearly 20 years later, planter after planter and other persons involved in management feel impelled to reiterate and reaffirm the defense which became the byword of the area in the late 30's: "Not one family, not one person has been displaced by machines on this plantation."

The years from 1935 to the present have seen a greatly augmented migration stream move out of the Delta to urban and industrial centers of the South, the North Central Region, and the West. The orientation of management currently is toward ways and means of retaining labor rather than toward ways and means for disposing of or replacing labor. The maintenance of favorable landlord-tenant or employer-employee relations has become and continues to be a dominant function of management. The successful operation of the cotton plantation depends upon the ability of management to maintain an adequate supply of labor to perform the operations which cannot yet be performed successfully by machines.

Traditionally, cotton production has been a hand labor operation, and therefore the plantation has been dependent upon an abundant supply of hand labor at a low cost. The arrangements by which the plantation operator assured himself of the continuing availability of labor range from the slave labor of the antebellum era to the seasonal migratory worker of the current period. The constant in all arrangements is the availability of housing on the plantation for the labor families.

Even a casual inspection of the number and location of houses on the two plantations reveals a basic difference in the underlying assumptions with which the managements approach the operation of the plantation. On Mule Plantation the assumption seems to be that though machines may take over eventually, men and mules will still be an important element in cotton production tomorrow. There are too many partly solved and unsolved links in the process for mechanized cotton production to be an immediate and real alternative. On Tractor Plantation the assumption is that machines—planters, flame cultivators, chemicals, mechanical pickers—will do the work tomorrow, but for the present much hand labor will be needed. Effective chemical and mechanical control of weeds and grass is possible even under field conditions in "normal" years. Next year may not be normal; therefore, hand laborers must be retained and hence employed even in normal years.

The story of housing on Mule Plantation is the story of growth and decline. In 1905 there were 92 houses for plantation workers. This represents the maximum number on the plantation and the houses were maintained until 1930. The owner allows that "We haven't built any new cropper houses since 1910, except to replace those that burned and since 1930 we haven't even replaced those that burned." The number of houses decreased by 7 percent in the decade 1930-40 and by 10 percent in the following decade. The loss from 90 houses in 1930 to 74 in 1951 represents the normal attrition resulting from fire and disuse. "It probably isn't good management," the owner remarked "but we haven't torn any houses down or attempted to salvage the lumber for other uses."

When the comparison is made in terms of occupied houses a better evaluation of the labor force is obtained. In 1951 only 56 of the 74 houses were occupied, leaving nearly 25 percent of the houses empty (Table 1). On Mule Plantation this represents a loss of only 7 percent since 1940. The sharpest decline in the number of occupied houses, 31 percent, came in the depression decade from 1930-40, (Table 2). Prior to that, in the judgment of the owner, there never were more than one, two or at the most three empty houses in any crop year. Before 1930 management frequently found it necessary to turn workers away, except during the relatively short period of labor shortage in 1928-29 and during World War I.[3]

As noted above, no new houses have been built since 1920 and there has been no attempt to relocate the houses (Figure 3). The houses that are less accessible have been allowed to fall down or have not been replaced. The summary figures show a net loss of 37% in the number of occupied houses from 1920-1951.

The unoccupied houses on the plantation are, with few exceptions, located on the back "forties" away from roads and inaccessible to the plantation headquarters (Figure 1). The adjoining fields, it will be noted are no longer in cotton. When the plantation manager rode out on a horse it was still possible to supervise work on the back forties but now that he rides around in a car, supervision becomes difficult and furthermore most croppers[4] today want access to a road. For all practical purposes the houses on the back forties have been abandoned.

A second reason for the abandonment of these houses is the dominant soil type in the area. This is a heavy clay soil, locally known as "buckshot," which has poor internal drainage and hence is difficult to work in wet years. During the 1920 decade with the depletion of the lighter soils, cotton was planted on these heavy soils with reasonable success. However, with the promotion in the 1930 decade and following of extensive use of commercial fertilizers these heavier soils were again taken out of cotton because they did not respond as well to fertilizers as the lighter soils.[5]

Table 1. Number of cropper and labor houses on the Case Study Plantation, Bolivar County Survey, 1951.

	Tractor		Mule	
	No.	%	No.	%
Total houses	107	100.0	74	100.0
Occupied	90	84.1	56	75.7
Unoccupied	17	15.9	18	24.3

The unoccupied houses that are located along the roads are not in use for various immediate reasons. In one case the cropper farming the tract lives in town. In another the family skipped out during the night and if the survey had been made a week earlier the house would have been occupied. Another had been rented, but the cropper failed to move in when he was supposed to and then it was too late to get another family.

The houses on Tractor Plantation are assembled along two main roads and around the plantation headquarters (Figure 2). There are 107 tenant and labor houses on the plantation, but only 90 of them are occupied (Table 1). The few houses still standing in the fields will be moved or torn down as soon as there is time. The houses that have been moved have been repaired and electricity has been installed. It is significant that the houses have not been enlarged or otherwise improved. It is apparent that even though management has gone to the expense of relocating the houses the possibility of eventual abandonment is real and not too distant. This practice of relocation may represent an intermediate step in the transition to full mechanization. Eventually, as the labor force becomes stabilized and the need for field hands sharply reduced, it is possible that even some of the relocated houses will be torn down and further improvements will be made on the remaining houses. This, at least, has been observed on one or two plantations, where the labor force consists of the tractor drivers and mechanics necessary to maintain and operate the equipment.

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[3] The extent to which curtailment in labor can be ascribed to partial mechanization, is discussed in the section "Machine vs. Mules." A second factor—that of the "cotton acreage reduction program" is discussed at the end of this section.

[4] Cropper is the term generally used in the area to designate the worker family which supplies only the labor in the production of cotton and receives its renumeration in the form of a share, usually one-half of the crop. (See section on "Tenure Arrangements.")

[5] The distribution of soils by type is discussed more fully in the section, "Land Use."

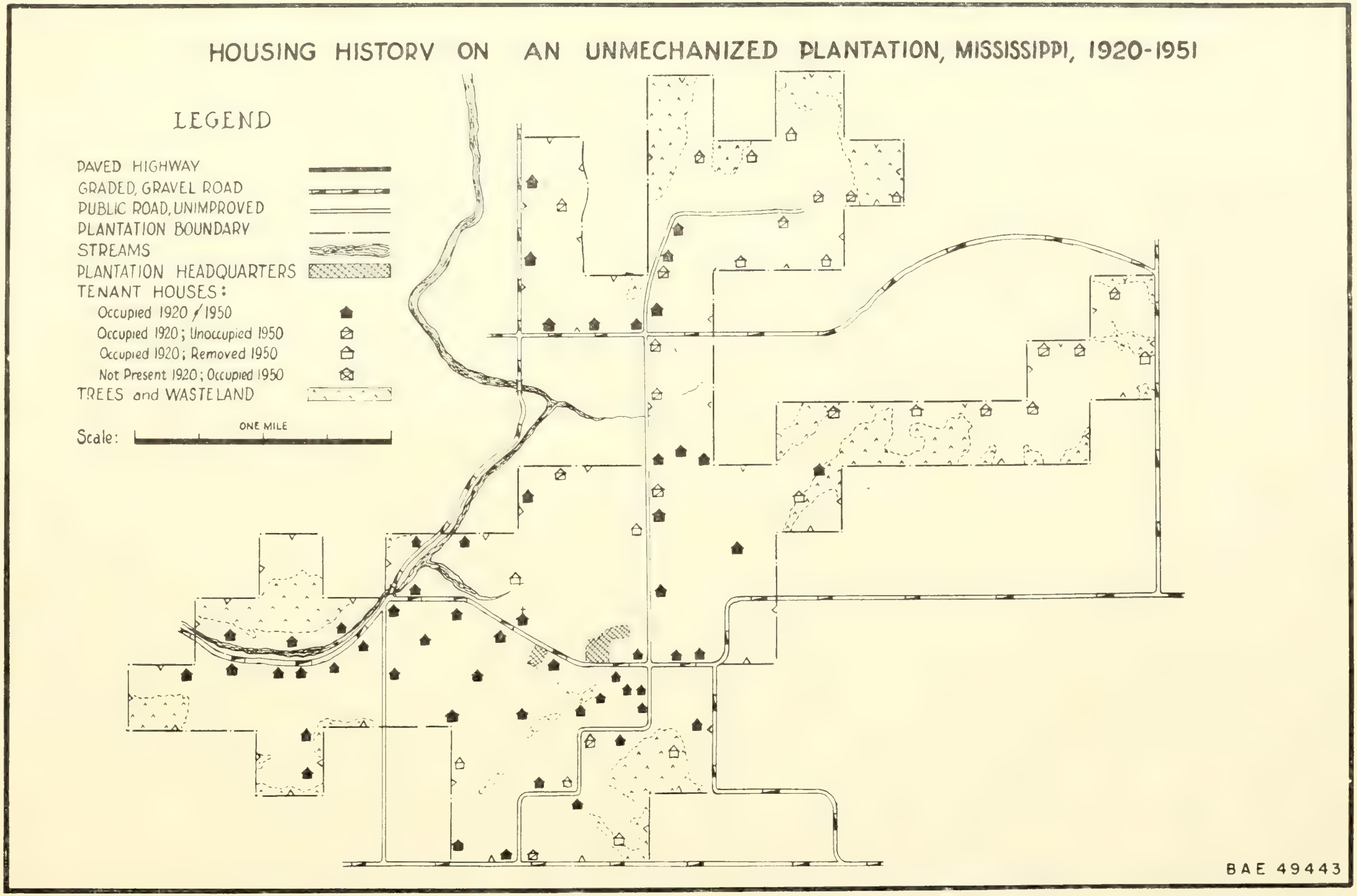
HOUSING HISTORV ON AN UNMECHANIZED PLANTATION, MISSISSIPPI, 1920-1951
LEGEND
DAVED HIGHWAY
GRADED, GRAVEL ROAD
PUBLIC ROAD, UNIMPROVED
PLANTATION BOUNDARY
STREAMS
PLANTATION HEADQUARTERS
TENANT HOUSES:
Occupied 1920 / 1950
Occupied 1920; Unoccupied 1950
Occupied 1920; Removed 1950
Not Present 1920; Occupied 1950
TREES and WASTELAND
Scale:
ONE MILE
BAE 49443

Figure 3. Housing history on Mule Plantation, Bolivar County, Mississippi, 1920-1951.

In 1920 there were 136 houses on the land which now comprises Tractor Plantation.[6] By 1951 the total number of houses as noted above had decreased to 107 with only 90 occupied. This represents a net loss of 34% as compared to 37% on Mule Plantation. The lower proportionate loss on Tractor Plantation can be ascribed in part to the higher yields and in part to the higher proportion of lighter soils on the plantation. Management on Tractor Plantation was able to expand cotton acreage following the removal of controls without taking in much of the heavier soil area on the plantation. Mule Plantation, in contrast, would have to expand into the heavy "buckshot" soil which were abandoned when controls were introduced.

The sharpest decline in the number of houses occurred in the decade 1930-40. If we assume that all houses on the plantation were occupied in 1940 and earlier, then there is a more marked decline in the number of occupied houses in the decade 1940-50 (Table 2). This assumption is not entirely justified since defense production with an expanding labor demand in industry had already begun by 1940. The number of houses indicates that there has been a consistent but increasing reduction in labor on the plantation since 1930.

The relocation of housing presents an even more marked transition than does the reduction in number (Figure 4). In 1930 the 136 houses were scattered over the plantation but in 1951 they had been assembled. By relocation of housing and turn rows the fields have been opened up to accommodate the new 4-row equipment which was adopted on the plantation in 1946.

The comparative figures for the two plantations present strong evidence in support of the contention that factors other than machines have been instrumental in bringing about the reduction in labor force. Production controls, no doubt, contributed to dissatisfaction and a high level of mobility among cropper families in the first decade of the period. For the nation as a whole the acreage planted to cotton declined 38 percent from the 1931-33 average to the 1940-42 average which roughly coincides with the two earlier periods for which housing data were obtained.

Table 2. Number of occupied houses for selected years on the Case Study Plantations, Bolivar County Survey, 1951.

	Tractor		Mule	
	No.	% change	No.	% change
1905	117	—	90	—
1920	136	16.2	89	—1.1
1930	133	—2.2	87	—2.2
1940	114	—14.3	60	—31.0
1951	90	—21.1	56	—6.7

The data for Bolivar County, in which these two plantations are located, is equally revealing. The acreage planted to cotton in 1932 before the imposition of acreage controls was 266,000 acres. In 1934 after the imposition of controls, only 179,000 acres were planted to cotton. This represents a reduction of 87,000 acres or 33 percent of the 1932 acreage. The acreage removed from cotton was at first planted to corn and hay—later to oats, hay, soybeans and pasture—all of which are less labor intensive crops than cotton. After 1934 both the acreage planted to cotton and the yield per acre increased, so that in the late thirties the labor surplus created by the initial reduction in acreage had been partially absorbed. Nevertheless, if a constant ratio of acres per worker were maintained, the plantations could expect to lose nearly a third of their workers during the decade. Since the late 1930's the high level of business activity and industrial employment brought on by the onset of the war in 1939 and our entry in December 1941 opened up alternative opportunities for the plantation labor force and spurred large numbers into migrating from the area.

Plantation Management

The operation of a plantation is a big business which involves the establishment of personal relations between two and three hundred people on each of the two plantations studied. The business becomes more complex as the

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[6] Nearly one-third of the land was acquired since 1920, but it was possible to secure accurate information about housing for the acres added to the plantation.

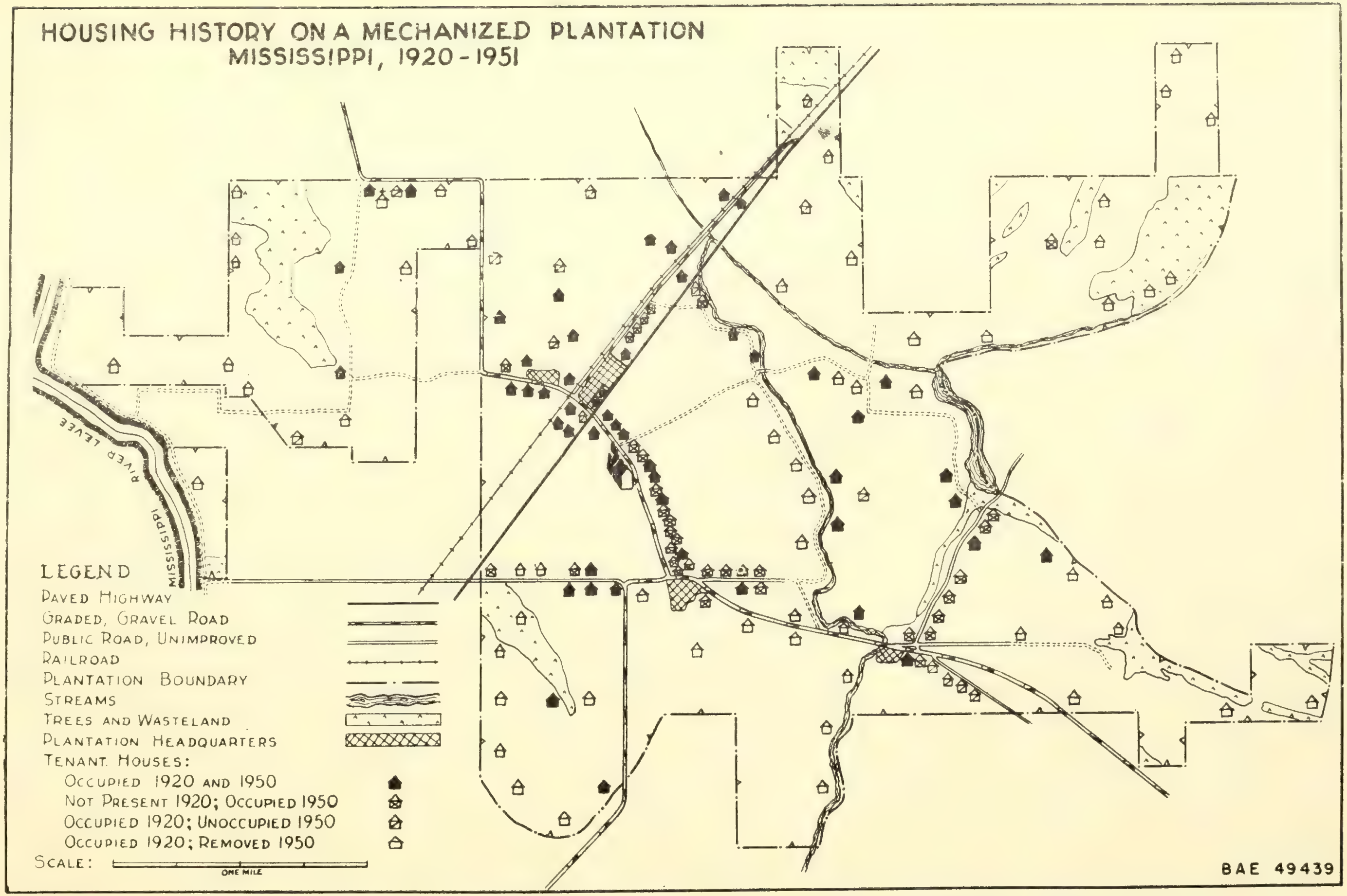
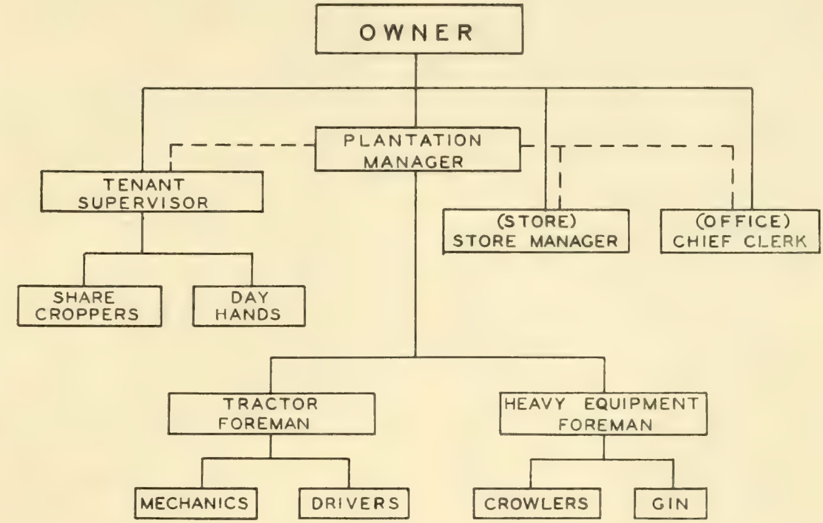
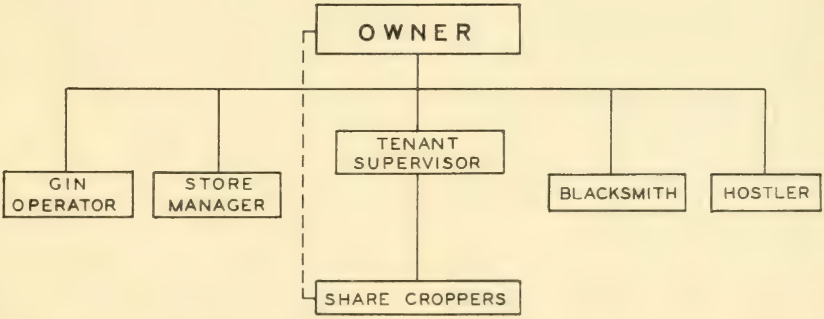

HOUSING HISTORY ON A MECHANIZED PLANTATION
MISSISSIPPI, 1920-1951
LEGEND
PAVED HIGHWAY
GRADED, GRAVEL ROAD
PUBLIC ROAD, UNIMPROVED
RAILROAD
PLANTATION BOUNDARY
STREAMS
TREES AND WASTELAND
PLANTATION HEADQUARTERS
TENANT HOUSES:
OCCUPIED 1920 AND 1950
NOT PRESENT 1920; OCCUPIED 1950
OCCUPIED 1920; UNOCCUPIED 1950
OCCUPIED 1920; REMOVED 1950
SCALE:
ONE MILE
MISSISSIPPI RIVER LEVEE
BAE 49439

Figure 4. Housing history on Tractor Plantation, Bolivar County, Mississippi, 1920-1951.


OWNER
PLANTATION MANAGER
TENANT SUPERVISOR
(STORE) STORE MANAGER
(OFFICE) CHIEF CLERK
SHARE CROPPERS
DAY HANDS
TRACTOR FOREMAN
HEAVY EQUIPMENT FOREMAN
MECHANICS
DRIVERS
CROWLERS
GIN

ORGANIZATION CHART FOR A MECHANIZED PLANTATION, MISSISSIPPI, 1951


OWNER
GIN OPERATOR
STORE MANAGER
TENANT SUPERVISOR
BLACKSMITH
HOSTLER
SHARE CROPPERS

ORGANIZATION CHART FOR AN UNMECHANIZED PLANTATION, MISSISSIPPI, 1951

Figure 5. Organizational structure of management on Tractor and Mule Plantations, Bolivar County, Mississippi, 1951.

operation becomes more mechanized largely because the mechanized operation requires a higher capitalization. The increasing complexity of the operation is reflected in the management hierarchy on each of the two plantations.

The organizational structure on Mule Plantation is relatively simple (Figure 5). The owner of the plantation is in direct communication with every tenant and worker on the place. At "furnish"[7] and settlement time the owner sits behind the counter in the office and deals directly with each of the tenants as they come before him. The tenants are greeted by their first names and the good work of the past year is commended or the slovenly work is condemned. The tenants, furthermore, come directly to the owner with their special problems, such as sickness, trouble with the law, etc., whenever and wherever the occasion arises.

When the commissary was in operation the store manager was directly responsible to the owner and frequently the owner might help out in the store, at least to the extent of recording the advances to each of the tenants as they came in for provisions. The blacksmith and the mule hostlers, likewise, are directly responsible to the owner in the performance of their duties.

There is, however, a plantation foreman who in some instances serves as the intermediary between the plantation tenants and the owner. The foreman's primary function is to see to it that the crop is put in and taken care of. He is the legman in the management hierarchy. He makes the rounds to check on the tenants during the working season. He is the plantation rider. This doesn't mean that the owner himself doesn't make the rounds of the plantation. He does this several times a week or even a day—sometimes with the manager and sometimes alone.

The manager in addition is responsible for the "day crop"[8] on the plantation and for the supplementary crops other than cotton. Working the supplementary crops, however, is incidental to his primary function as overseer for the tenants. He has little or no responsibility for, or contact with, the allied functions of the plantation such as the store, gin, the mule barns, and the blacksmith, except at the direction of the owner.

As mechanization and diversification of an operation increase the management structure becomes more complex. The organization chart for Tractor Plantation still shows the direct line of communication from the owner through the tenant supervisor to the sharecroppers (Figure 5).

However, the organization chart reveals that this phase of management has become a subsidiary phase on Tractor Plantation. The owner has acquired an overall manager and his primary responsibility is for the performance of machine operations on the plantation. He is in essence the supervisor for the "day crop." When it comes to the utilization of labor the division of responsibility between the tenant supervisor and the plantation manager becomes a little cloudy. There are some operations in which he must deal with the tenant supervisor but the manager is solely responsible for the supervision of the tractor work. The supervision is delegated to a tractor foreman and a foreman in charge of heavy equipment. The tractor foreman has supervision over the maintenance and operation of all the row-crop equipment. The heavy equipment foreman is responsible for the crawler type tractors and for the maintenance and operation of the gin.

On Tractor Plantation the line of communication from the individual worker to the plantation owner has been broken. The worker deals almost solely with the tenant supervisor or with the plantation manager. Some few workers of long standing might conceivably find their way to the plantation owner but throughout the period of the study which covered about three months during which several conferences were held with the owner, none of the workers did seek access to him.

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[7] "Furnish" is the term used to designate advances made by management to the tenants for subsistance during the crop year. In addition farm operating costs are carried by management and collected at settlement time.

[8] "Day crop" is used here to designate that portion of the cotton acreage which is not allotted to tenants but is handled by management using workers paid by the day. It is sometimes also called "operator cotton" or "wages cotton."

This is in sharp contrast to the situation observed on Mule Plantation, where each interview with the owner was interrupted by at least one plantation worker seeking the counsel of the owner.

On Tractor Plantation there are essentially two operating units. The one is the mechanized operation and the other is the hand labor operation. The two merge at some points but in essence an independent structure has been developed for the mechanized operation. The hand labor operation survives much as it was prior to the introduction of mechanized equipment.

Tenure Arrangements

Throughout the Delta considerable thought has been given through the years to the ways and means for securing and retaining labor for the plantation. The basic tenure arrangement is the half and half share-cropper agreement. Under this arrangement the tenant supplies all labor required for the production of the crop. The distribution of other costs of production such as poisoning, fertilizer, and other items has been worked out in each area. The presence or absence of a commissary, the kind and amount of "furnish," all enter into the labor recruitment situation. As tractors are introduced to the operation some of the labor normally performed by the tenant is performed with tractor equipment. The cost of the operation is charged against the tenant's crop.

The half and half arrangement continues to be the customary basis for bargaining between landlord and tenant. On Mule Plantation there are two tenants on the home place who farm on the one-third and one-fourth rental agreement and who supply some of the capital requirement for the operation. The plantation also has two wage hands. The remaining 52 labor families are sharecropper families.

On Mule Plantation tractors are used primarily at the discretion of the cropper with the exception that where experience has taught the plantation manager that a family consistently gets behind in its work he will insist that the particular tract is machine planted so that it can be cultivated with a multiple row cultivator, otherwise the probability is very great that a crop will not be harvested on that field. The charges assessed against the sharecropper for tractor work on Mule Plantation are minimum charges, apparently based on current operating expenses with little overhead included in the cost.

The tenant has the privilege of applying the seed to the ginning cost or of collecting the seed money and paying a fixed charge of sixty cents per 100 pounds for ginning plus $3.50 for packing and ties for each bale. In the latter case the cost of ginning is deferred until settlement time.

The commissary on Mule Plantation has been closed for nearly a decade. In the early 20's the commissary was closed for the first time and cash furnish was given to the sharecroppers. This was necessary to meet the competition for labor from other planters who at that time had begun to pay a cash "furnish." During the early 20's the workers wanted cash for automobiles and other luxury items. However, about 1930 the commissary was reopened and "furnish" was advanced in the form of coupons which could be used only in the commissary. The commissary remained in operation until the advent of rationing at which time management again closed the commissary because it was too much trouble to keep up with the ration coupons.

The plantation owner repeatedly commented that they were not in the merchandising business and had no interest in becoming established in it. The primary business of the plantation is cotton production. If it is necessary to run a commissary to maintain labor they will run a commissary, but if they can do without it they have no intention of operating a grocery and dry goods store.

Currently on Mule Plantation a cash "furnish" is made to the plantation labor force every four weeks beginning the first of March and continuing through July. The last "furnish" is given either in the last week in July or in the first week in August. The "furnish" for the four-week period ranges from $10 to $14 for single individuals and from $50 to $75 for larger families. At present there are some families that are able to finance themselves.

The tenant can arrange for settlement any time after he has two bales to his credit. Settlement day is Thursday on Mule Plantation and usually begins the third Thursday in October. Traditionally, if a tenant does not make a profit on the crop some adjustment is made. Usually about half of the indebtedness is written off and half of it carried forward on account for the next year. The owner commented that if the debt was too large the tenant would skip out and he would lose his labor; therefore, it has become customary to write off some of the indebtedness.

On Tractor Plantation the prevailing arrangement currently is that of wage labor though the tenure pattern is much more complex than on Mule Plantation. In 1940 only 400 of the 1450 acres in cotton were cultivated with day labor. In 1951, the relationship had been reversed with 1200 acres cultivated by day laborers and only 450 acres by tenants or sharecroppers.

Currently the plantation has one renter and one sharecropper who do all the work with mules. These are exceptions. There are 29 sharecropper families on the plantation and 37 families which though ostensibly sharecroppers represent an innovation in labor relations on the plantation. The male heads of these 37 families are day laborers on the plantation. As an added incentive to stay on the plantation the wife is given a cropper tract of three acres in which she has a share in the crop and on which she is expected to perform the labor. The plantation also has 16 full-time wage hands. These plus the 37 wage hands whose wives have a crop make 53 wage laborers. The tractor drivers and mechanics are included in the 53 regular wage hands.

Beginning as early as 1905 breaking and planting on Tractor Plantation was done by the landlord. Up to 1945 the tenant continued to be responsible for cultivation, chopping and picking, the first operations being performed with mule equipment. In 1945 four-row equipment was acquired and cultivation was added to the operations performed with machines, leaving for the tenants only the hand labor operations of hoeing and picking. The transition to four-row equipment and tractor cultivating was completed in two years with less than a third of the tenants using mules to cultivate their crops in 1946. By 1947 the mule inventory on the plantation was reduced to 12 mules and all field operations were performed with tractors.

By making these adjustments management on Tractor Plantation has made available a plantation labor force which can work on the day crop after they have finished the work on their own tracts. On Tractor Plantation it is unnecessary for management to hire off-the-plantation labor for weed control except during extremely wet periods. The sharecropper labor force is organized into labor gangs and there are four or five labor foremen who are responsible for these when they work in other fields on the plantation.

By giving tenant families first chance at day-labor work, management has reduced the need for continuing advances through the growing season. The tenant families normally draw more in wage labor than the operating charges against their cropper tracts. The wages on the day crop are paid in cash on a weekly basis and the charges against the crop are carried until settlement time. Management, therefore, has been able to do away almost entirely with a weekly or monthly "furnish."

Skilled Workers

One of the major problems confronting management on a plantation that is being mechanized is the recruiting and training of tractor drivers and operators of the heavy equipment being introduced into the farming operation. Neither of the plantations studied has developed a very definite policy with respect to this problem.

On Mule Plantation in 1951 there were 10 tractor drivers and the manager of the plantation observed that he never went out to look for tractor drivers. There are always applicants for the jobs. Most of the tractor drivers grew up on the plantation or were kinsmen of tenant families on the plantation or they have married into the plantation families. Furthermore, all the drivers on Mule Plantation have a regular crop and drive tractors only when the work on their own crop is caught up.

For 1951 the payroll account on Mule Plantation lists 10 regular tractor drivers with an average of 7 years experience as drivers. Seven are men who have lived on the plantation for 20 years or more, including six who were born on the plantation. Two men have lived there for 10-15 years and one for less than 10 years. The 10 drivers include 3 who have driven for 10 years or more, 4 for 5-9 years, and 3 for less than 5 years. The entire period as drivers for some of the workers has not been on Mule Plantation.

Another measure of the stability of tractor drivers on Mule Plantation may be obtained by comparing the roster of drivers for an earlier year with the current roster. Data were obtained for the year 1944, which was 7 years earlier. At that time there were 5 drivers on the plantation. Of the 5, only two were driving tractors in 1951 on Mule Plantation. Of the remaining 3 one had migrated North, one had left the plantation but was still in the county, and one had been committed to the Federal Penitentiary on a liquor charge.

The comparative data indicate a relatively high mobility of the skilled worker. Only 2 of the current group have been driving tractors on the plantation for as much as 10 years. They have lived on the plantation most of their lives and learned to drive tractors in the more recent years. They are replacements for earlier tractor drivers. It is unlikely that more than one or two of the 7 drivers with less than 10 years experience will remain on the plantation for ten years or more.

The story for Tractor Plantation is not much different. In August 1945 there were only 13 tractor drivers on the plantation payroll. Of these, only 4 still remain as tractor drivers on the plantation, five have moved North, two have been killed, one has been committed to the penitentiary, and one has moved to another plantation.

In 1951 the plantation had 22 tractor drivers. Six of these were Displaced Persons who had been brought to the plantation about two years earlier. The remaining 16 were Negro workers. Nine of the Negro drivers were brought up on the plantation and 3 others have lived on the plantation for 10 years or more. The average length of time that the drivers have been driving tractors is about 6 years. Only 8 were sufficiently skilled to be entrusted with the operation of either the mechanical cotton picker or the self-propelled combine.

In the judgment of the tractor supervisor only about 40 percent of the drivers trained by the plantation remain on the plantation. Of those that leave, nearly 40 percent migrate to northern industrial centers and about 20 percent find employment as bulldozer operators and drivers of other types of dirt-moving and road-maintaining equipment in the Delta. The tractor supervisor remarked that they were planning to initiate a tractor school to train some of their own personnel to operate the equipment.

In terms of both sets of comparative data Tractor Plantation has experienced a higher loss of drivers than Mule Plantation. This may be, in part, a derivative of the differences in tenure arrangements observed on the two plantations. As noted earlier the drivers on Mule Plantation are croppers first and drivers second, thus having an interest in the crop and tenure rights in the land. The drivers on Tractor Plantation are drivers only and have no interest in the crop or tenure rights in the land, except that management has found it expedient in some instances to award a crop to the wife of the driver on the assumption that this would tend to hold the driver on the plantation.

Machines vs. Mules

Neither of the plantations studied are solely dependent on either tractors or mules in the performance of field operations. The one, Tractor Plantation, depends more on tractors and the other more on mules to supply the work power in the field. The difference between the two is a difference in emphasis, a difference in degree of mechanization.

In 1923 the workstock inventory was at its maximum on Mule Plantation with 98 head. The mule book for the plantation was begun around 1920 and the record of sales, deaths and purchases is available for each year. The mule inventory fluctuates around 85 for most of the period up to 1945. It drops below 80 in the period 1928-34 and again in 1945 when the inventory is 76 head. The year 1945 is the beginning of the period of reduction and the number of mules is 48 in 1951.

The first tractor, a Clete, was acquired in 1920. The second was purchased in 1929 and sold two years later. In 1935 the tractor inventory is two. Tractors continue to be incidental until 1948 when the inventory rises to 7. In 1951 the plantation has 9 tractors but only 5 of them, including two 4-row cultivators, are equipped with cultivator attachments.

On Mule Plantation tractors are used primarily on the land not planted to cotton. As neighboring planters began to use tractors on cotton land Mule Plantation secured tractors that were made available to the individual tenant on request. This continues to be the policy of management. Whether or not tractor work is performed on a given field is determined between the landlord and the tenant usually when they bargain for a crop in the spring. Even stalk cutting, breaking, and discing operations are not performed "through and through" on Mule Plantation. There are some croppers who perform these operations with mules. Management insists that the spring work be done with tractors when dealing with some croppers because "Experience has taught us," in the words of the landlord, "that these particular croppers make a habit of getting behind and if we are going to make a crop on their land we have to be able to go in there with tractors during the cultivating season. You can't cultivate a field with a 2-row or 4-row cultivator unless it has been planted with a 2-row or 4-row planter."

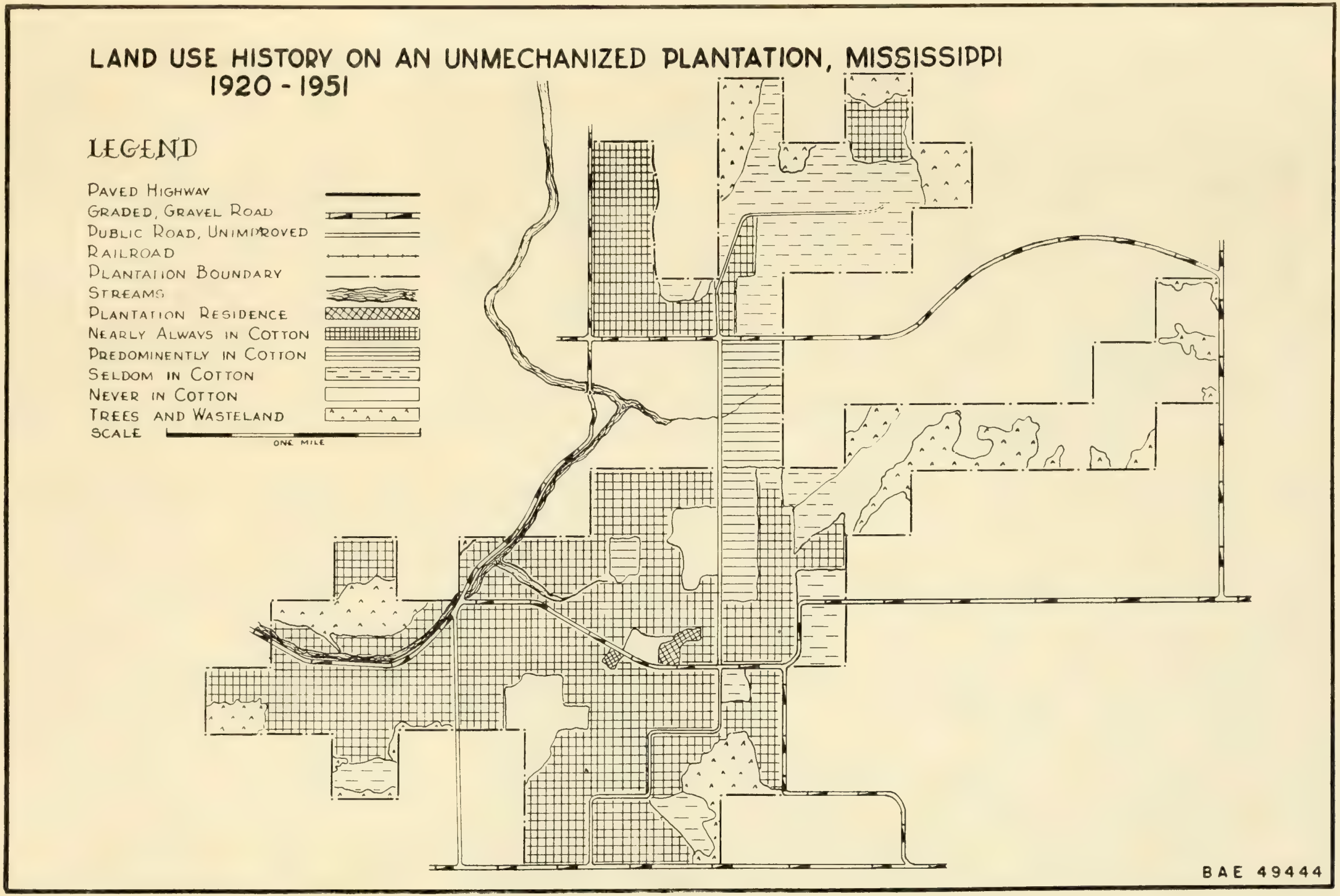
The charge for tractor work is figured on a cost basis. The figures quoted for work done on specific plots range from $1.60 an acre for stalk cutting, breaking, and discing to $4.40 per acre on a tract where the tractor operations were carried through to two cultivations. These are the actual charges recorded in the plantation record book for two specific tracts.

Spraying and dusting are performed at the sole discretion of management and for the entire acreage. The cost is charged against the cropper tract on a prorata basis. The tenant is charged for all the labor costs on these operations and normally the cost of materials are shared 50-50 between landlord and tenant.

The equipment inventory on Mule Plantation does not include a mechanical cotton picker nor has any of the cotton been harvested with machines. Machine harvesting would entail expensive modernization of the gin which is not necessary as long as the tenants can continue to harvest their own cotton.

On Tractor Plantation the mule records are not as detailed as are the records on Mule Plantation. The maximum number of mules recorded is 105 head in 1935. The mule inventory remained at about 100 head until 1945 when half of them were disposed of at a mule sale. The following year another sale was held and the inventory was brought down to 12 head which has been maintained since that time.

There are two transition years on Tractor Plantation, 1935 and 1945. Prior to 1935 there were three heavy-duty steel-wheeled tractors on the place. In 1935 one of these was replaced with two row-crop tractors and another row-crop


LAND USE HISTORY ON AN UNMECHANIZED PLANTATION, MISSISSIPPI
1920 - 1951
LEGEND
PAVED HIGHWAY
GRADED, GRAVEL ROAD
PUBLIC ROAD, UNIMPROVED
RAILROAD
PLANTATION BOUNDARY
STREAMS
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NEARLY ALWAYS IN COTTON
PREDOMINENTLY IN COTTON
SELDOM IN COTTON
NEVER IN COTTON
TREES AND WASTELAND
SCALE
ONE MILE
BAE 49444

Figure 6. Land use history on Mule Plantation, Bolivar County, Mississippi, 1920-1951.

tractor was added the following year. The transition was completed in 1937 when the inventory consisted of 7 row-crop tractors all equipped with 2-row cultivator attachments. The inventory increased to 12 by 1942 and remained at that number through the war period.

In 1945, though the tractors found little use in the 1945 crop season, the transition to 4-row equipment was begun and the 1946 crop year finds the inventory at 18 four-row tractors. One crawler or caterpillar was added to do the heavy work in the spring. In 1951 the inventory stands at 21 four-row tractors and 2 crawlers.

Mechanical cotton pickers were introduced on the place in 1948 with 4 one-row units. The following year 2 additional one-row units were added and in 1950 two 2-row pickers were added, making a total inventory of 8 mechanical pickers in 1950 and 1951. The 12-foot self-propelled combines complete the inventory of major equipment for 1951.

On Tractor Plantation the cropper's responsibility for the cotton begins when the plants "show green in the row." He supplies the hand labor necessary to grow cotton on the acreage assigned him and must harvest his own crop. When that is done he can work on the "day crop" for cash wages, if there is a need for day labor. The field operations from planting to harvesting is a "through and through" operation.

The present owner may not fare so well in comparison with his two predecessors if expansion is measured in terms of acres added to the plantation. The transition in operating method though is revolutionary. It is a transformation that is equalled or exceeded on few plantations in the area.

Land Use

Prior to 1933 and the advent of government regulation and controlled production, there are few data on acres planted on either plantation. The cropper tracts, as one owner remarked, more or less grew up as the plantation was cleared and the houses were built. These tracts haven't changed much through the years. The number of acres in each wasn't important. The tract was measured rather in terms of its ability to produce cotton.

The philosophy credited earlier to the owner of Mule Plantation, "Let the other fellow pay the taxes on the poor land" was not an idle boast. This is revealed by the high ratio of the land used for crops, namely, 83 percent and nearly 88 percent if the improved pasture is included. The Plantation, however, is no longer as distinctively a cotton factory as was true before the crop control program was enacted. Cotton acreages which currently range around a thousand acres approached 2000 prior to 1933. The highest measured acreage planted since then was 1466.5 in 1937. The year of the plow-up approximately 1300 measured acres were harvested. Since 25 percent of the planted acres were plowed under, an estimated 1750 acres were planted in cotton in that year. In its heyday as a cotton factory, cotton was harvested from more than 60 percent of the land in the plantation annually.

Aside from the stream beds and adjoining woodland areas there is very little land on Mule Plantation that has never been planted to cotton (Figure 6). The block of land south and west of the plantation headquarters is cotton land and, except for the meadow west of the house, has been used as such every year since the plantation was organized. The tracts of land farther away from headquarters and from the road have been planted to cotton when and if tenants could be secured for them. In periods of labor abundance, families could be secured for the back "forties." Characteristically, these families received little supervision and seldom 'paid off." In periods of labor scarcity the back "forties" remained idle.

Another factor contributing to the distribution of cotton acraege on the plantation is the distribution of soil types. The soil survey for the farm reveals that about ten percent of the area falls in the Class I soil group.[9]

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[9] The soil surveys for the plantations were prepared by the County Soil Conservation Service. See also G. E. Rogers and H. B. Vanderford, **Bolivar County Soils,** Bulletin 489, March 1952 Mississippi State College, Agricultural Experiment Station.

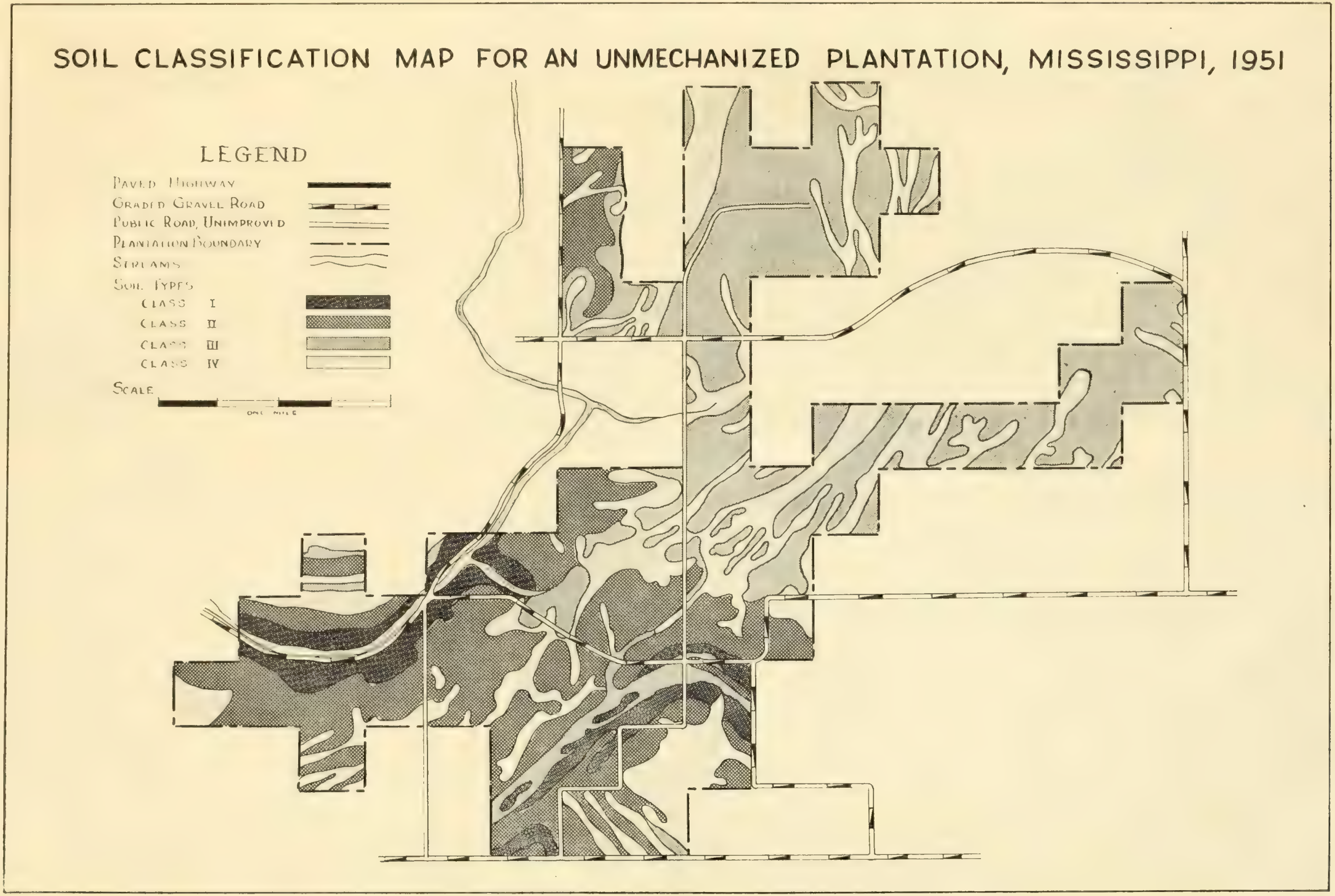

SOIL CLASSIFICATION MAP FOR AN UNMECHANIZED PLANTATION, MISSISSIPPI, 1951
LEGEND
Paved Highway
Graded Gravel Road
Public Road, Unimproved
Plantation Boundary
Streams
Soil Types
Class I
Class II
Class III
Class IV
Scale
One Mile

Figure 7. Soils Classification on Mule Plantation.

This is a high proportion for that section of the county. Class I soils are the light sandy loam and silt loam soils which have made the Delta famous as a cotton producing area. The soils on about 25 percent of the area are Class II soils which also are high producing soils but which require more careful management if yields are to be maintained. Soils in the remaining areas of the plantation are Class III or poorer soils. These can be used effectively for cotton production only under the most favorable weather conditions and then only if adequate surface drainage can be provided. The latter soils predominate on the back "forties" of the plantation. The nature of the soils, no doubt, is a strong contributing factor to the inability of management to maintain labor on these tracts and helps to explain why the back "forties" seldom paid off (Figure 7).

On Tractor Plantation 56 percent of the land is currently used for crops. An additional 17 percent is in improved pasture, which brings the total improved land up to 73 percent of the total acreage or 3000 acres. Thirty-six percent of the total or 50 percent of the improved land is currently planted to cotton. The acreage in cotton has ranged from around 1300 to 2000 acres. Prior to 1933 the acreage planted to cotton seldom fell below 50 percent of the acreage in the plantation.

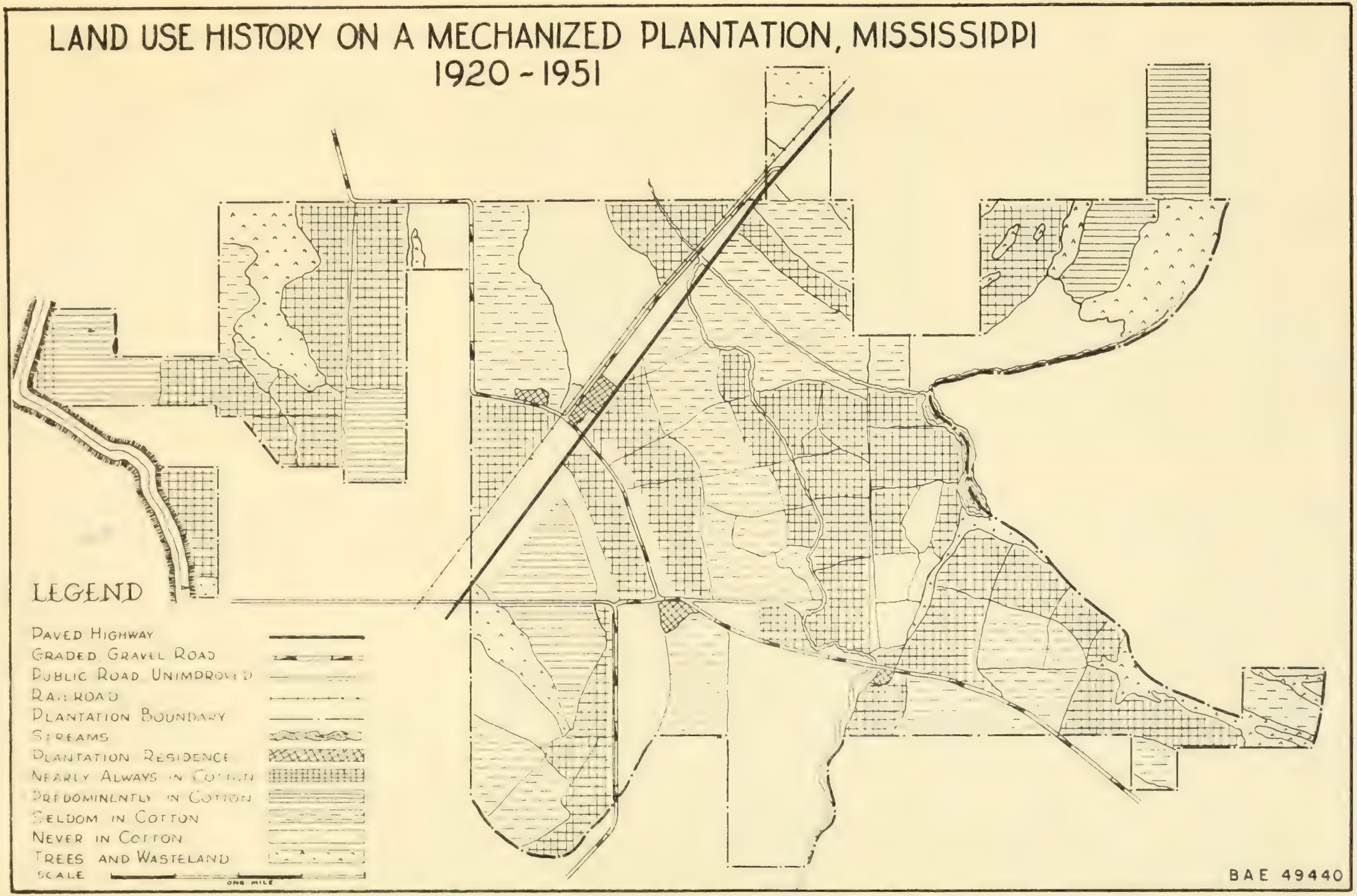
Aside from the segments of waste and forest land on the plantation most of the land has been used for cotton at some time or other. Around a third of the acreage has been planted to cotton every year since the tract was added to the plantation. Another fourth of the land has been used dominantly for cotton and then there is some additional land that has been planted to cotton only in exceptional years (Figure 8).

The soil survey for Tractor Plantation shows that with only minor exceptions, all the land always or predominantly in cotton falls in the Class I or Class II soil groups. These soils predominate on approximately half of the plantation area. In years of production controls, when acreage allotments are in effect, some of these soils must be diverted to other crops. Even in years of expanding acreages management still has a backlog of fair cotton land that can be brought into production, if labor is available and the price seems to justify it (Figure 9).

The historical land use patterns for the two plantations show that in the pre-depression era nearly 2000 acres on the two units were planted in cotton annually. Both units curtailed the acreage planted when production controls were initiated in 1934. The acreage planted in cotton fluctuates around 1200 acres from 1935-1939 on each plantation. In the next five year period 1940-1944 the acreage on Mule Plantation is reduced to around 1000 acres; whereas, on Tractor Plantation the acreage planted is increased to 1400 acres. In the post-war era from 1945-1949, the opposing trends continue and the acreage on Mule Plantation ranges around 800, whereas on Tractor Plantation the acreage varies around 1600 acres.

The diverging trends in acreage and the difference in the productive capacity of the land on the two plantations have resulted in a lower total production on Mule Plantation. Since 1940 production on Mule Plantation has not been over 1000 bales in any year, whereas on Tractor Plantation production has never fallen below 1000 bales in any year. The range on the former is from 482 to 961 bales and on the latter from 1105 to 2136 bales. Neither the high records nor the low records fall in the same year on the two plantations. The variation in production reflects the vicissitudes of controls, weather, and labor supply and the responses of the plantation managements and the plantation soils to these variables.

The more intensive cultivation and the retirement of the poorer soils from cotton production on Mule Plantation are accompanied by a slight net increase in yields per acre. For the five year period 1935-1939 the average yield of lint per acre is just over 350 pounds, as compared to just under 400 pounds for the period 1945-1949. In contrast, Tractor Plantation has expanded its cotton acreage and substituted tractor power for mule power and hand labor.


LAND USE HISTORY ON A MECHANIZED PLANTATION, MISSISSIPPI
1920 - 1951
LEGEND
PAVED HIGHWAY
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RAILROAD
PLANTATION BOUNDARY
STREAMS
PLANTATION RESIDENCE
NEARLY ALWAYS IN COTTON
PREDOMINENTLY IN COTTON
SELDOM IN COTTON
NEVER IN COTTON
TREES AND WASTELAND
SCALE
ONE MILE
BAE 49440

Figure 8. Land use history on Tractor Plantation, Bolivar County, Mississippi, 1920-1951.

During this period the 5-year average yield has dropped from nearly 600 pounds on the restricted acreage in 1940-1944 to below 500 pounds on the expanded acreage in 1945-1949.

At the present level of operation Mule Plantation averages approximately 15 acres of cotton per occupied house. Based on the 5-year average yields this results in a net production of 11 bales of lint per occupied house. The more extensive operation on Tractor Plantation only averages 18 acres in cotton per occupied house but when combined with the higher yields obtained, the plantation shows a net production of 16 bales of lint per occupied house. The higher capitalization has enabled the latter plantation to absorb a 15 percent net loss in average yields and still produce nearly 50 percent more cotton per unit of labor than was produced on the unmechanized plantation.

Summary and Conclusions

The preceding analysis is concerned primarily with the distribution of people on the land, the factors which are associated with the observed historical changes in the distribution, and the resulting differences in distribution between the two plantations. The observations are indicative of the effects which differing management policies will have and should be viewed as tentative hypothesis subject to further verification.

The two plantations were selected because the managements have adopted divergent methods to cope with the problem of labor scarcity. Mule Plantation is a tenant operation and continues to use mules as the primary source of work power, but has a few tractors which are available to the tenants on request. Tractor Plantation is primarily a "day crop" operation and is extensively mechanized with tractors used for all operations at the convenience of the manager. The few tenants remaining are responsible for hand labor — hoeing and picking — on the acreage assigned to them. The "day crop" is machine harvested.

The cropper tract is the unit of operation on Mule Plantation. Housing is associated with the tract and dispersed on the plantation. If a house is empty, the field adjoining it is idle. If a house stands empty for more than one season, the field adjoining will in all probability be diverted to crops other than cotton. The field is the unit of operation on Tractor Plantation. The houses are no longer associated with specific tracts and have been moved out of the fields to locations on three main roads. The fields are prepared and planted by the tractor crew and at hoeing time a number of rows are assigned to the cropper. The acreage thus assigned accounts for less than a fourth of the total acreage planted.

The decline in occupied houses has been greater on Mule Plantation (37 percent) than on Tractor Plantation (34 percent). The availability of tenants, willing to bargain for specific tracts is the primary determinant of cotton acreage in any given year on Mule Plantation. Historically management has found it difficult in periods of labor scarcity to secure tenants for the heavier, poorly drained soils and most of this land has been taken out of cotton.

Soil type, price, and the availability of labor substitutes—tractors, chemicals and mechanical pickers—are the primary determinants of cotton acreage in any given year on Tractor Plantation. The acreage is determined and labor (resident or non-resident) or labor substitutes necessary to do the job are secured.

Tenure rights in the land are recognized as an important factor in recruiting and retaining labor on both plantations. All workers are tenants on Mule Plantation. The cropper arrangement predominates, but there are some renters. All workers are potential "day hands" on Tractor Plantation. Tenure rights to a crop are assigned to a worker, or to his wife, if this is necessary to secure his services as a hoe hand, tractor driver or mechanic.

The phenomenon which distinguishes the management on Tractor Plantation from Mule Plantation is the new management hierarchy which is being established to operate and maintain the tractor equipment. There are in essence

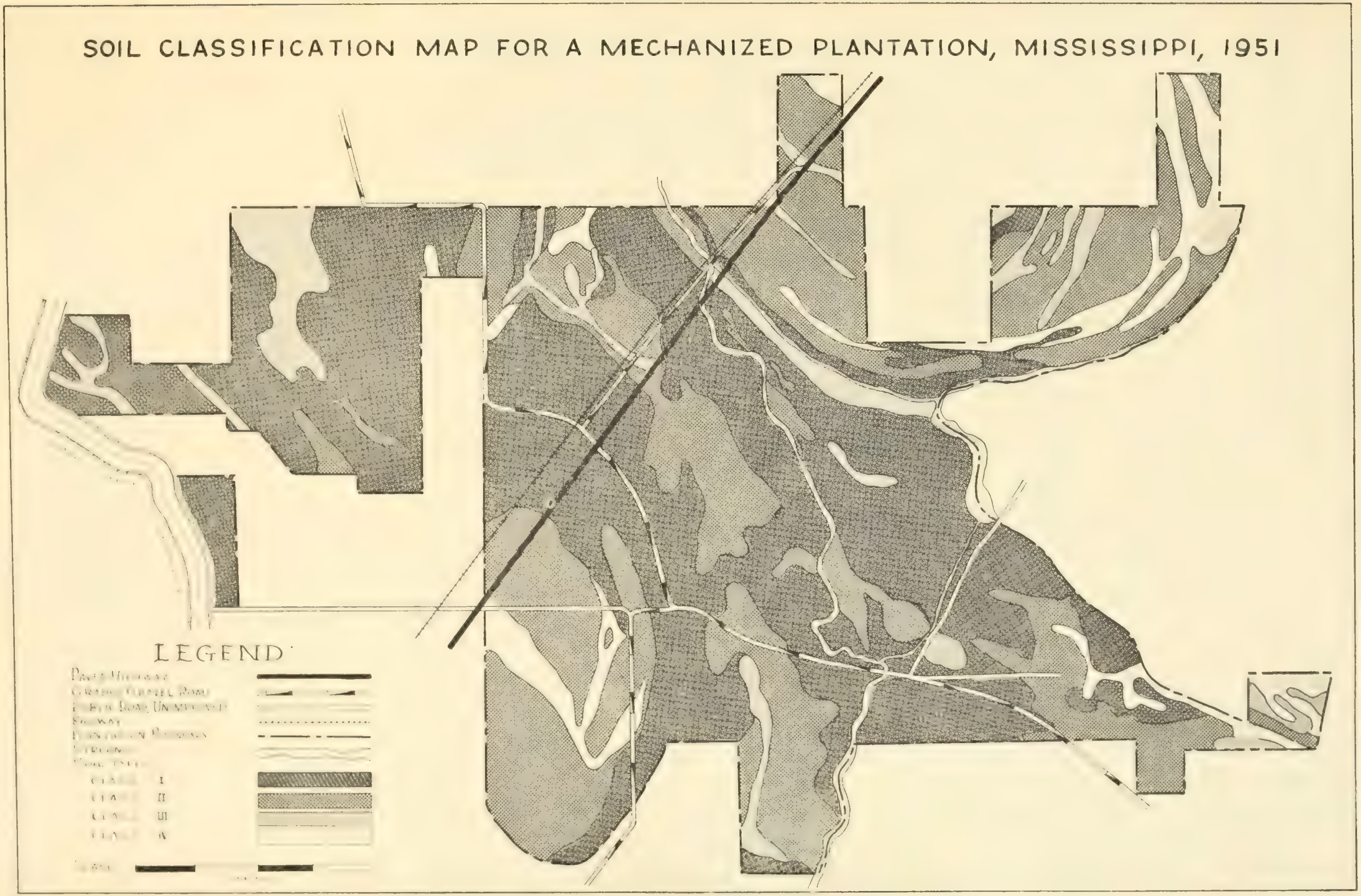
SOIL CLASSIFICATION MAP FOR A MECHANIZED PLANTATION, MISSISSIPPI, 1951
LEGEND
Paved Highway
Graded Gravel Road
Earth Road, Unimproved
Railway
Plantation Boundary
Stream
Soil Type
Class I
Class II
Class III
Class IV

Figure 9. Soils Classification on Tractor Plantation.

two operating units on Tractor Plantation. One unit is operated under the traditional sharecropper system and in 1951 accounted for less than one-third of the cotton acreage on the plantation. The remaining two-thirds of the crop is in management or day cotton. All hand labor for the operation is hired on the day-wage basis and as much of the work as possible is done with tractor equipment. When possible the day hands who work on the operator cotton are secured from the tenant families on the plantation and paid a fixed daily wage which is determined at the time the families bargain for the current crop.

Mechanization on Mule Plantation is nominal and includes only preplanting operations and some cultivation. Most of the cultivating on Mule Plantation is done with mules. In contrast mechanization on Tractor Plantation is extensive, including even some weed control operations, such as flame-cultivation and chemical weed control. Nearly 70 percent of the cotton crop on Tractor Plantation has been harvested with machines each year for the past 4 or 5 years.

Neither plantation has embarked upon a clearly defined program for selecting and training operators of the mechanized equipment on the farm. Literally, if a man wants to drive a tractor and he can keep the tractor in the row he can become a tractor driver. Tractor Plantation did inaugurate in the fall of 1951 a training school for tractor drivers which was designed to acquaint the potential drivers with the operation and maintenance of the equipment. It is too early to assess the effect of this program on the skill and efficiency of the drivers on the plantation.

Looking to the future the development of the fully mechanized operation will result in the elaboration and specialization of the mechanized wing of the management structure, and in the deletion of the tenant wing of the structure. It is unlikely that this will be attained, however, until such time as management can see itself no longer dependent upon a relatively large hand labor force. Currently management on Tractor Plantation is willing to pay the additional cost of the sharecropper program in order to retain the labor force for work when needed on the operator cotton. The decision to retain a sharecropper arrangement on a portion of the plantation is made not so much in terms of the economies of the operation as it is in terms of the availability of labor. The operator of a mechanized plantation who does not have an accessible labor force must depend upon the availability of sufficient workers in nearby towns and villages. When he competes for this non-resident labor the cost of weed control becomes higher on a per-day basis, but the critical problem is that he is never completely sure on any given day or in any given week that he will be able to obtain the 100 or 200 workers which he needs if he is to get through the fields in the time available.

BULLETIN 509 JANUARY 1954

MISSISSIPPI
COTTON VARIETY TESTS

1953

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

1953 Cotton Variety Tests
IN HILL SECTIONS

By J. F. O'KELLY, S. P. CROCKETT, B. C. HURT and K. C. FREEMAN

There are several cotton varieties well adapted to the cotton producing areas of the state and the tables which follow report comparative results obtained with these during the 1953 season. It will be seen from the average results that there is not always a great deal of difference between the high and low producers and that even the low producers provide attractive returns in total value per acre.

Soil moisture, as in 1952, was so low during the flowering season that yields were reduced, except possibly at State College. Rainfall in mid-July was a little more than five inches at State College. This made possible the development of a vigorous, well-rooted plant which was able to set a good crop of bolls in spite of later moisture deficiencies. At the other locations moisture was never quite adequate after the plants started flowering.

The fertilizer used varied considerably. That at Holly Springs was 500 pounds 8-8-4 per acre; at Pontotoc (both tests) it was 600 pounds 12-8-8; at State College it was 700 pounds 6-8-8; and Newton it was 600 pounds 12-8-8. Some of the low yields in the Newton test are due in part to a hard pan in the subsoil. This reduces yields in dry seasons and in some seasons when there is excessive rainfall. Even so, it is difficult to find a crop which will give more return per acre on this type of soil than cotton.

The use of insecticides together with the dry weather controlled the boll weevil until the beginning of migration in late summer.

There was no appreciable damage from fusarium wilt but it may be well to point out that, among the varieties tested, Coker Wilt, Plains, Empire, and Auburn 56 are the most resistant to this disease.

As usual the prices used for lint cotton were averages of ten weeks of the marketing season beginning with the last week in August. The value used for seed was $55.00 a ton.

In the tables reporting averages the acre values are based on lint of middling grade and the value of the seed. In these averages Delfos 651 was used in 1949 and 1950 and Bobshaw 1 was used in 1949.

Cotton varieties, State College, 1953.

	Pounds lint per acre	Total acre value			Lint percentage	Length, inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Miller	775.6	295.14	288.93	267.99	37.4	1	164
Louisiana 33	773.6	295.70	289.51	268.63	38.6	1 1/32	176
Delfos 7343	771.2	304.65	298.48	274.96	36.9	1 3/32	195
Hi-Bred	758.3	262.44	255.24	242.35	39.8	7/8	149
Coker Staple	750.1	299.51	293.51	270.64	34.9	1 3/32	200
Arkot 2-1	741.9	298.43	291.50	268.87	34.2	1 3/32	181
Fox	732.3	288.71	282.12	261.25	35.6	1 1/16	207
Empire	730.2	287.25	280.68	259.87	36.0	1 1/16	162
Deltapine 15	726.3	282.39	275.85	255.15	38.3	1 1/16	201
Stoneville 2B	717.6	283.38	276.92	256.47	35.3	1 1/16	175
Stoneville 5A	690.3	265.99	260.46	241.83	37.0	1 1/32	188
Plains	683.2	268.90	262.75	243.28	35.9	1 1/16	170
Auburn 56	653.2	257.52	251.64	233.02	35.6	1 1/16	183
Delfos 9169	644.6	257.24	252.08	232.42	35.0	1 3/32	187
Coker Wilt	620.6	245.79	240.82	221.90	36.4	1 3/32	187
Bobshaw 1A	617.0	242.72	237.16	219.58	36.0	1 1/16	194

Average results from cotton varieties, State College.

	Pounds lint per acre					Averages				
	1949	1950	1951	1952	1953	Lint	Acre value	Lint percentage	Length inches	Bolls per lb. lint
Deltapine 15	345	556	523	601	726	550	230	40.0	1 1/16	186
Plains	403	469	514	640	683	542	226	37.7	1 1/32	174
Delfos 7343	339	431	532	615	771	538	228	37.3	1 3/32	197
Miller	308	465	516	602	776	533	220	37.6	31/32	172
Coker Staple	347	436	485	627	750	529	226	36.1	1 3/32	199
Delfos 9169	361	360	477	688	645	502	213	36.1	1 3/32	184
Hi-Bred	340	336	548	520	758	501	190	41.5	7/8	149
Empire	387	307	503	569	730	499	207	37.2	1 1/32	163
Coker Wilt	343	411	509	586	621	494	210	36.8	1 1/16	187
Stoneville 2B	300	347	455	632	718	490	205	36.9	1 1/32	178
Bobshaw 1A	381	396	442	556	617	478	200	36.8	1 1/32	197

Cotton varieties, Newton, 1953.

	Pounds lint per acre	Total acre value			Lint percentage	Length, inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Hi-Bred	355.6	121.29	117.97	111.87	42.9	7/8	186
Fox	344.1	131.41	128.66	119.36	38.3	1 1/32	241
Auburn 56	320.2	122.57	120.01	111.04	38.3	1 1/32	216
Deltapine 15	318.2	119.55	117.01	108.10	42.5	1 1/32	228
Coker Wilt	297.0	115.15	112.47	104.01	38.9	1 1/16	198
Miller	295.8	110.22	107.12	99.13	39.5	31/32	203
Arkot 2-1	293.7	114.70	112.06	103.69	37.4	1 1/16	225
Empire	282.9	106.77	104.51	96.59	41.4	1 1/32	199
Coker Staple	276.1	107.72	105.23	97.36	37.6	1 1/16	243
Plains	275.5	104.68	102.47	94.76	39.9	1 1/32	223
Stoneville 2B	269.4	102.97	100.82	93.27	38.6	1 1/32	198
Louisiana 33	266.3	98.68	95.89	88.70	40.7	31/32	228
Bobshaw 1A	261.1	98.15	96.06	89.01	39.9	1	255
Stoneville 5A	259.1	97.14	95.07	88.07	40.5	1	241
Delfos 7343	246.2	92.76	90.79	83.90	41.8	1 1/32	240
Delfos 9169	242.9	92.93	90.99	84.19	38.4	1 1/32	232

Average results from cotton varieties, Newton.

	Pounds lint per acre					Averages				
	1949	1950	1951	1952	1953	Lint	Acre value	Lint percentage	Length inches	Bolls per lb. lint
Bobshaw 1A	245	556	452	160	261	335	142	38.1	1	247
Hi-Bred	274	420	466	154	355	334	128	42.1	27/32	197
Empire	283	577	336	164	283	329	139	39.1	1 1/32	199
Stoneville 2B	267	518	411	168	269	327	140	37.6	1 1/32	214
Coker Wilt	258	510	401	166	297	326	140	37.2	1 1/16	231
Deltapine 15	308	529	331	137	318	325	135	40.8	1 1/32	230
Miller	191	495	412	151	296	309	130	38.0	31/32	223
Plains	245	518	318	164	275	304	129	38.3	1 1/32	236
Delfos 9169	233	474	367	155	243	294	128	37.4	1 1/16	223
Coker Staple	181	464	372	166	276	292	127	36.7	1 1/16	258
Delfos 7343	223	414	377	142	246	280	119	38.7	1 1/16	249

Cotton varieties, Holly Springs, 1953

	Pounds lint per acre	Total acre value			Lint percentage	Length, inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Hi-Bred	596.7	211.36	205.99	191.08	40.6	29/32	176
Plains	494.7	193.78	189.33	175.23	36.8	1 1/16	203
Fox	487.9	191.93	187.54	173.64	36.0	1 1/16	246
Miller	485.6	187.02	183.13	170.02	37.1	1 1/32	208
Empire	473.3	186.09	181.83	168.34	36.1	1 1/16	189
Auburn 56	473.0	188.86	185.08	170.65	34.9	1 3/32	217
Stoneville 5A	449.2	172.55	168.96	156.83	37.6	1 1/32	233
Coker Wilt	443.5	176.02	172.47	158.94	36.0	1 3/32	234
Delfos 7343	435.6	171.55	168.06	154.78	37.5	1 3/32	243
Delfos 9169	431.2	169.91	166.03	153.74	35.7	1 1/16	209
Louisiana 33	430.6	163.78	160.33	148.70	37.5	1	218
Arkot 2-1	418.6	167.92	164.57	151.81	34.1	1 3/32	247
Deltapine 15	401.2	155.61	152.00	140.57	38.8	1 1/16	225
Coker Staple	393.9	157.65	154.50	142.48	34.5	1 3/32	245
Stoneville 2B	379.1	149.46	146.05	135.24	35.6	1 1/16	211
Bobshaw 1A	374.6	147.37	144.00	133.32	36.0	1 1/16	228

Average results from cotton varieties, Holly Springs.

	Pounds lint per acre					Averages				
	1949	1950	1951	1952	1953	Lint	Acre value	Lint percentage	Length inches	Bolls per lb. lint
Delfos 9169	563	568	456	447	431	513	207	37.0	1 1/16	193
Plains	470	593	404	450	495	482	199	38.7	1	190
Empire	565	502	381	456	473	476	195	39.0	1 1/32	168
Hi-Bred	528	426	411	415	597	475	178	42.6	27/32	159
Coker Wilt	514	573	406	414	444	470	196	37.7	1 1/32	197
Deltapine 15	551	526	399	452	401	466	189	40.6	1	200
Coker Staple	547	566	374	435	394	463	194	36.9	1 1/16	214
Miller	498	484	408	405	486	456	183	38.4	15/16	187
Delfos 7343	496	478	436	409	436	451	187	38.4	1 1/32	213
Stoneville 2B	457	518	430	460	379	449	188	37.2	1 1/32	190
Bobshaw 1A	447	534	424	439	375	444	184	37.6	1	214

Cotton varieties, Flatwoods Soil, 1953

	Pounds lint per acre	Total acre value			Lint percentage	Length, inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Louisiana 33	399.3	156.83	153.24	141.86	36.3	1 1/16	217
Hi-Bred	392.4	139.67	136.14	126.33	39.6	29/32	200
Miller	389.2	153.53	150.03	138.93	35.5	1 1/16	204
Stoneville 5A	385.2	150.66	147.19	136.22	37.1	1 1/16	220
Empire	381.1	148.46	145.03	134.17	37.9	1 1/16	178
Delfos 9169	374.3	149.71	146.71	135.30	34.6	1 3/32	211
Arkot 2-1	372.6	148.86	145.88	134.52	34.8	1 3/32	196
Stoneville 2B	364.4	144.57	141.29	130.90	34.5	1 1/16	221
Coker Staple	359.8	143.67	140.79	129.82	34.9	1 3/32	233
Auburn 56	352.6	141.35	138.53	127.78	34.2	1 3/32	219
Plains	325.5	138.90	135.72	125.68	35.7	1 1/16	216
Delfos 7343	350.7	137.03	133.87	123.87	37.3	1 1/16	229
Deltapine 15	344.2	134.77	131.67	121.86	36.9	1 1/16	246
Coker Wilt	341.6	136.64	133.90	123.49	34.6	1 3/32	219
Bobshaw 1A	340.5	134.09	131.03	121.32	35.8	1 1/16	222
Fox	338.9	133.68	130.63	120.97	35.5	1 1/16	236

Average results from cotton varieties, Flatwoods Soil, Pontotoc.

	Pounds lint per acre		Averages				
	1952	1953	Lint	Total acre value	Lint percentage	Length inches	Bolls per lb. lint
Hi-Bred	388	392	390	142.98	41.1	13/16	184
Stoneville 5A	326	385	356	142.92	38.2	31/32	214
Stoneville 2B	344	364	354	146.65	36.2	1	218
Plains	355	352	354	143.86	37.6	1	201
Arkot 2-1	334	373	353	147.26	35.8	1 1/32	202
Empire	324	381	352	143.08	39.1	1	164
Miller	308	389	349	140.16	36.8	15/16	196
Auburn 56	335	353	344	141.21	36.2	1	208
Fox	346	339	343	139.84	36.9	1	230
Delfos 9169	300	374	337	141.26	36.0	1 1/16	195
Bobshaw 1A	326	340	334	137.90	36.6	1	218
Delfos 7343	298	351	324	131.90	38.9	1	222
Coker Staple	288	360	324	135.55	36.0	1 1/16	220
Deltapine	302	344	323	131.25	39.2	1	224
Coker Wilt	300	342	321	133.42	36.0	1 1/32	212

Cotton varieties, Pontotoc Ridge Soil.

	Pounds lint per acre	Total acre value			Lint percentage	Length, inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Hi-Bred	382.4	140.70	136.69	123.49	39.6	15/16	186
Empire	375.0	144.88	141.88	131.75	36.5	1 1/32	181
Plains	354.7	140.39	137.20	127.09	34.9	1 1/16	216
Bobshaw 1A	352.5	136.48	133.66	124.14	36.1	1 1/32	233
Arkot 2-1	348.5	140.42	137.28	127.35	32.0	1 1/16	247
Delfos 9169	344.0	137.20	134.10	124.30	33.6	1 1/16	223
Miller	343.0	132.25	129.51	120.25	35.0	1	222
Delfos 7343	336.9	132.75	129.72	120.12	35.7	1 1/16	245
Stoneville 5A	336.6	130.54	127.85	118.76	35.8	1 1/32	249
Fox	336.6	133.46	130.43	120.84	34.6	1 1/16	255
Coker Staple	336.4	135.77	133.08	122.82	33.1	1 3/32	251
Stoneville 2B	333.9	132.10	129.42	120.41	32.5	1 1/32	227
Auburn 56	330.5	131.82	128.84	119.42	33.6	1 1/16	232
Coker Wilt	317.9	127.43	124.57	115.52	32.8	1 1/16	239
Deltapine 15	313.2	121.27	118.76	110.31	36.1	1 1/32	243
Louisiana 33	307.6	117.99	115.53	107.23	35.9	1	242

Average results from cotton varieties, Pontotoc Ridge Soil.

	Pounds lint per acre		Averages				
	1952	1953	Lint	Total acre value	Lint percentage	Length inches	Bolls per lb. lint
Hi-Bred	300	382	341	126.96	41.1	13/16	177
Empire	292	375	334	134.58	38.4	1	165
Plains	283	355	319	129.54	37.2	1	201
Bobshaw 1A	284	352	318	129.92	36.8	1	224
Delfos 7343	292	337	315	128.52	38.1	1	230
Fox	292	337	314	128.28	36.4	1	240
Deltapine 15	312	313	312	126.54	38.1	1	222
Miller	280	343	312	123.82	36.6	15/16	205
Delfos 9169	269	344	306	128.06	35.5	1 1/16	201
Auburn 56	281	330	306	125.23	35.9	1	214
Arkot 2-1	254	348	301	125.70	34.4	1	227
Coker Staple	265	336	301	126.60	35.0	1 1/16	228
Stoneville 5A	263	337	300	119.67	37.5	31/32	229
Stoneville 2B	260	334	297	122.31	35.2	1	208
Coker Wilt	256	318	287	119.16	35.2	1	222

IN THE DELTA

By JAMES B. DICK and ZANE F. LUND

Standard cotton variety field trials were conducted in 1953 at Stoneville and Yazoo City by the Delta Branch Experiment Station. Two other variety trials, at Money and Tunica, did not survive early season conditions. The Stoneville trial was planted on April 23 and produced an average seed cotton yield of 2730 pounds per acre. The Yazoo City test, conducted on the Schaffer Plantation, was planted on April 18. Because of heavy mortality from seedling diseases it was necessary to plant the test over on May 8. Average seed cotton yield was 1660 pounds per acre.

Temperatures in the Delta during most of the 1953 season were abnormally high. Some areas received sufficient rainfall and made "bumper crops." Rainfall at Yazoo City was deficient, as in 1952, with resulting reduced yields and shorter staple.

Boll weevil infestation throughout the season was generally light and was controlled by a thorough program of insect control on the test areas.

All varieties in the yield trials were the current improved strains of the reliable breeders or firms whose cottons are commonly grown on a large percentage of the Delta cotton acreage. Varieties are listed in each test in order of yield of lint per acre.

Yields of seed cotton and of lint per acre, gin turnout, and earliness are given for the two trials. The data is presented as a progress report.

Results of cotton variety yield trials Yazoo-Mississippi Delta, 1953.

Variety	Yield per acre		Gin turn out	Percent at first picking
	Seed cotton	Lint		
	Lbs.	Lbs.	Pct.	Pct.
STONEVILLE				
Empire	3100	1072	34.6	57
Deltapine 15	2695	1020	37.8	42
Stoneville 2B	3034	1014	33.4	36
D.E.S. 7343	2749	1006	36.6	46
Delfos 9169	2969	975	32.8	45
Stoneville 3202	2654	950	35.8	51
Bobshaw 1A	2563	894	34.9	44
Coker 100 Wilt	2666	898	33.7	45
Coker 100 Staple	2682	879	32.8	45
Fox	2540	874	34.4	59
Deltapride	2490	778	31.3	32
Wilds	2565	762	29.7	32
Planted April 23, first picking August 31				
YAZOO CITY				
Stoneville 3202	1893	720	36.5	
Fox	1789	674	36.3	
Empire	1763	652	36.0	
D.E.S. 7343	1665	621	37.6	
Delfos 9169	1687	614	35.5	
Stoneville 2B	1612	587	35.5	
Coker 100 Staple	1684	582	34.2	
Coker 100 Wilt	1655	572	35.3	
Bobshaw 1A	1537	552	36.5	
Deltapine 15	1313	531	39.1	
Planted May 8, picked October 9				